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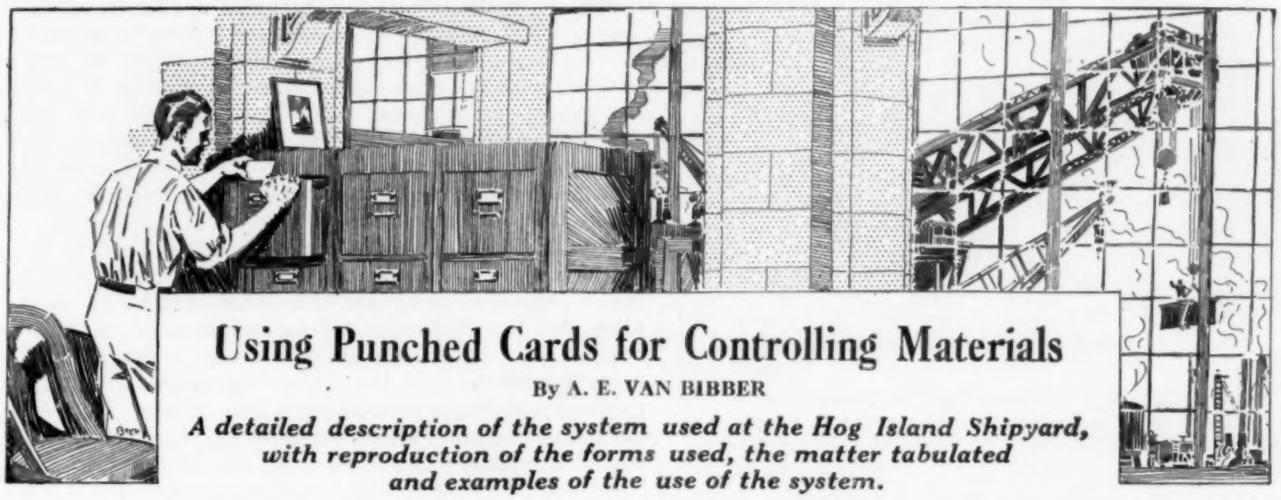


Using Punched Cards for Controlling Materials

By A. E. VAN BIBBER

A detailed description of the system used at the Hog Island Shipyard, with reproduction of the forms used, the matter tabulated and examples of the use of the system.

THE subject of records concerning finished parts, such as fabricated steel, machinery and fittings, was given considerable study by the American International Shipbuilding Corporation at Hog Island, Philadelphia, Penn., because three departments, the accounting department, the stores department and the production department, are interested in reports concerning such material. The accounting department is interested in the receipts of material for the purpose of auditing accounts payable; it is also interested in the disbursements of material from stores and the cost of the same in ships. The stores department is interested in knowing what is expected, a record of what it has received, a balance of what it has on hand, and a record of disbursements. The production department is interested in knowing the unshipped material, the expected date of shipments, material in transit, material on hand, and the planning of the distribution of the same to ships in accordance with a predetermined plan of production.

It was desirable to design a system of records which would furnish the above information to all departments, and inasmuch as the production department not only needs to know the history of material but the availability of it, a system of records was designed that would supply the stores and accounting departments with the necessary information.

The Problem Presented

The clerical work involved in handling any system was next considered, with the view of accomplishing two things, namely, the reduction of the possibility of human error and the employment of the minimum number of workmen.

It became obvious that the problem was a difficult one for the following reasons: First, there are between 15,000 to 20,000 different finished pieces entering into a ship, all of which must be recorded and kept track of. Second, the larger part of this number of pieces is impossible to designate separately by name. For instance, there are several nundred different shell plates, all of which are very much alike excepting in dimensions, and one cannot be distinguished from the other by name; hence the only identification is a numerical mark. There is great possibility of transposition of figures under such conditions every time they are written, and there is no check on such errors. Third, practically every piece that is disposed of from stores is sent out in quantities of one for each ship, which makes an enormous number of clerical entries necessary for 110 ships of the same type.

The question of introducing accounting machines to do this work of recording, was considered, and as a result a plan was developed whereby the Powers accounting machine was utilized to perform a large proportion of the clerical work.

The plan developed is as follows:

Bill of Material

A complete bill of material showing the different pieces that enter into construction work is prepared for each type of ship, and arranged in groups in sequence of erection. Each group is sub-divided into four parts, each part representing the section served by two of the eight derricks on each way, Fig. 1.

The bill of material is divided into two major parts, the hull fabricated steel and the machinery and equipment.

The bill of material for fabricated steel is prepared from the detailed drawings covering each piece of fabricated steel, and in addition to the piece mark, the calculated weight, location in the steel yard or store house, drawing number, erection-sequence group number, and crane section number are set down against each item as in Fig. 2. A linotype slug is then made containing all the information about each piece, which is proved against the bill of material.

The slug is then put in a press and three sets of Powers cards are printed, the number in each set corresponding to the total number of pieces that are to be used in the total number of ships in the group, which in the case of the first "A" series is 50. This makes a total of 150 cards. Each set is distinguished from the other by color; namely, white, green and salmon, Figs. 3 and 3a. As the white and salmon colored cards are in duplicate, except for color, but one is shown. After these cards are printed the information at the top is cut into a sample Powers card by a Powers gang punch.

This sample card is then recorded on a tabulating

AMERICAN INTERNATIONAL SHIPBUILDING CORPORATION
AGENT U. S. SHIPPING BOARD—EMERGENCY FLEET CORPORATION
BILL OF MATERIAL ARRANGED IN SEQUENCE OF ERECTION

"A" Ship — Navigating Bridge, Dk. Beams and Plates — Certified Correct — J. E. Moss — 6/12/18 — Group 47 — Sheet No. 434

Line	TITLE	Pcs	MARK	Breadth	Length	Weight	Dr'w'g	Class	Rivets	Check	Remarks
1	Dk. Beam	1	A271-4 x 6GCL	9" x 6"	54'10"	541	H6264	10	8	2	
2	"	1	" x 7GCL	" "	"	"	H6265	"	"	"	
3	"	1	" x 7ICL	" "	"	"	"	"	"	"	
4	Plate	1	" x A1	71-1/2" x 1/4"	22'5-1/4"	1353	H6254	4	108	"	
5	"	1	" x B1B	" "	11'2-1/2"	681	H6255	18	141	"	
6	"	1	" x B1P	" "	22'5-1/4"	1364	"	"	203	"	
7	"	1	" x B2S	" "	6'11-1/2"	544	"	"	109	"	
8	"	1	" x C1P	57-1/4" x 1/4"	22'5-1/4"	1092	H6256	"	125	"	
9	"	1	" x C1S	" "	"	"	"	"	103	"	
10	"	1	" x D1P	" "	"	"	H6257	"	279	"	
11	"	1	" x D1S	" "	"	"	"	"	"	"	
12	"	1	" x E1P	" "	"	1020	H6254	4	157	"	
13	"	1	" x E1S	" "	"	"	"	"	"	"	
14	"	1	" x F1P	" "	"	963	H6257	"	"	"	
15	"	1	" x F1S	" "	"	"	"	"	"	"	
16	"	1	" x 14P	12" x 1/4"	22'7"	346	H6267	1A	0	"	
17	"	1	" x 14S	" "	"	"	"	"	"	"	
18	Plate	1	A241 x 5-62	52" x 5"	14'8"	1128	H6263	10	18	"	
19	"	1	" x 6-62P	" "	20'8"	1409	"	"	21	"	
20	"	1	" x 6-62S	" "	"	"	"	"	"	"	
21	"	1	" x 20-62P	40" x 4"	4'6"	311	H6269	"	11	"	
22	"	1	" x 20-62S	" "	"	"	"	"	"	"	
23	Bett. Strap	1	" x 46-62S	5-1/2" x 7/16"	2'6-1/2"	21	H6362	21	20	"	
24											

FIG. 1. BILL OF MATERIAL

machine to prove the accuracy of the punching. If the tabulated record agrees with the printed record the card is proved correct. The gang punch, being set, punches in a minute and a half the 150 cards in accordance with the proved punch records, Fig. 4, which means that every time any one of the cards covering the particular piece in question is used it will record the same information. This is the same card after punching, and only one is shown.

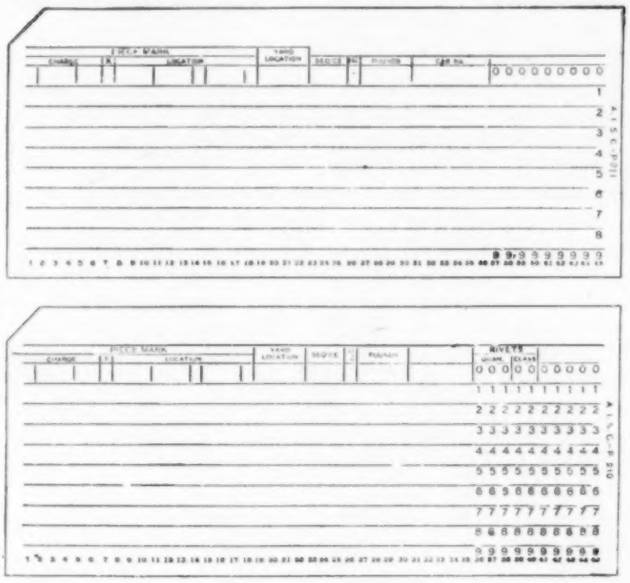
Determining the Cost

In addition to the foregoing information being gang-punched into all three cards the estimated cost of each piece is also gang-punched into the white and green cards, but not into the salmon colored cards. The cost of each piece, which is only approximate, is determined in the following manner:

1. The various kinds of fabricated steel are divided into various classes, according to the nature of the work, and the fabrication-class number is placed on the detailed drawing of each piece. This class number is set down against each item in the bill of material previously referred to.

2. The average price of each class of steel is determined by computing the total tonnage of fabricated steel ordered according to each class. Each fabricator's share of this tonnage is extended at the particular price paid each fabricator, which varies greatly. These extensions are totaled for each class, and divided by the grand total tonnage of each class, giving an average cost per ton for each class of fabricated material. To this average cost is added the cost per ton of steel, divided approximately according to the proportion of plates, angles or bars used, the average freight cost per ton between the mill and the fabricator, and the freight between the fabricator and Hog Island. A wastage factor for shrinkage of raw material is also included. This gives an average gross cost per ton for each class of fabricated material. This work is done in conjunction with the accounting department and is checked for general correctness. The costs naturally will not check up very closely in some cases with certain invoices, owing to the fact that there are great differences in some of the prices paid different fabricators for the same class of fabrication.

3. With these figures at hand the cost of each piece is computed by multiplying the class cost per pound herein referred to by the calculated weight of each piece, and the amount in dollars and cents is set down against each item of the bill of material. This in turn is gang-punched into the white and green cards and proved by the same method previously referred to. The calculated weights which are used as here described should run within 1 to 3 per cent. plus or minus of the actual shipping weights from the fabricators. If the actual weights vary more than this the matter should be taken up with the fabricator, with the view of determining whether or not an error has been made. It is customary in the structural-steel business to use the calculated weights as a basis of checking the fabricator's shipping weights in order to prevent excess weights in fabricating pieces, and consequently excess charges. No two pieces of fabricated steel shipped from the same fabricator at different times will have the same weight, but they should not vary more than the above percentages.



FIGS. 3 AND 3A. TWO CARDS FOR PUNCHING MACHINE

4. The methods of material costing as outlined are in accordance with customary standard practice in the usual manufacturing plants, and while it is not absolutely accurate, the expense of attempting to allocate each invoice proportionately to its final usage would involve such a tremendous clerical expense and a possibility of error that the ends would not justify the means. For this reason the above procedure is sufficiently accurate for all cost purposes.

5. The method of reporting costs of ship steel erected are described later.

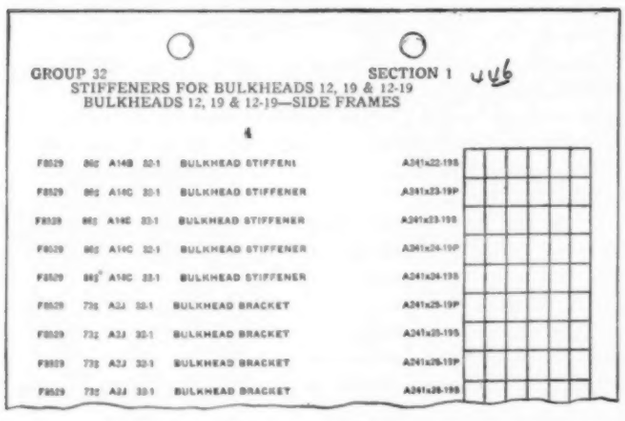


FIG. 2. ADDITIONAL INFORMATION CARD

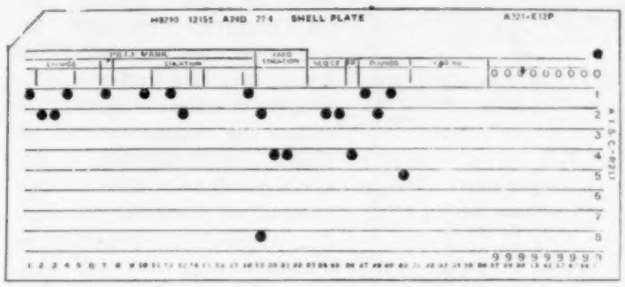


FIG. 4. CARDS AFTER PUNCHING

6. The various account numbers of the Emergency Fleet Corporation covering fabricated hull steel are used as a basis of reporting all cost information to the accounting department.

After the three sets of Powers cards with the various punchings are made for each piece the white and salmon cards are filed in alphabetical-numerical order in special filing cabinets behind division guides headed for each piece mark. The green cards are sorted by a Powers sorter to ships in erection order and by crane section, so that there is a complete set of green cards for each ship, filed by four crane sections, and in sequence of use under each section. The sets of green cards are sent to the appropriate shipyard administration buildings according to hull numbers. In the case of the 50 "A" ships there will be five complete hull files in every shipyard administration building, each file containing a separate Powers card for each item of the bill of material.

A special shipping manifest has been designed for the fabricator's use in reporting by mail on the day of shipment every carload shipped, giving the railroad car number and initial, route, the consecutive American International Shipbuilding Corporation shipment number, date of shipment, marks of piece shipped and quantity of each, together with the shipping weights. This is shown in Fig. 5. The manifest is forwarded to the production department direct by the fabricator or the American International Shipbuilding Corporation inspector at the fabricating shop.

Telegraphic advice of a general nature is also received from fabricators on the day of shipment for each carload shipped. When the manifest is received by the production department a white card and a salmon card are removed from the file for each piece listed, and the shipping date is rubber-stamped on each card. The fabricator's number and his consecutive car shipment number are then gang-punched into all of the said cards and the combination of the fabricator's number and consecutive shipment number serves as an index against the car number, and is recorded in a car-shipment register book, Fig. 6.

The salmon colored cards are then tabulated in duplicate and checked against the manifest, placed in an envelope, together with a copy of this tabulation, and sent to the steel yard where the material is to be unloaded. Fig. 7 and Table I shows this.

The white cards are filed in erection sequence in a file known as the material in transit file, from which for production purposes any piece in transit and its car number can be determined.

The carbon copy of the tabulated record is retained in the office as a record of the material in each car in transit. A third copy of this can be made and forwarded to the accounting department for the purpose of showing the calculated weight of every shipment as a means of checking the shipper's weights, inasmuch as the calculated weight is tabulated, together with the total weight by the adding-machine feature of the tabulating machine.

Checking Material as It Is Unloaded

When a car is unloaded at the steel yard it is checked by the salmon colored cards which have been previously sent down for all the material contained in the said car.

TABLE I. TABULATION WHICH ACCOMPANIES CARD

A231	3XA		5		A 4 M	292	2858	17	292	1
A231	3XA		5		A 4 M	292	2858	17	292	1
A231	3XB		10	P	A 4 M	294	3281	17	292	1
A231	3XB		10	P P	A 4 M	294	3281	17	292	1
A231	3XB		10	P P	A 4 M	294	3281	17	292	1
A231	3X	D	12	S S	A 4 K	294	3338	17	292	1
A231	3X	D	12	S S	A 4 K	294	3338	17	292	1
A231	3X	D	12	S	A 4 K	294	3338	17	292	1
A231	3X	D	12	S P P	A 4 K	294	3338	17	292	1
A231	3X	D	12	S P P	A 4 K	294	3338	17	292	1
A231	3X	D	12	S P P	A 4 K	294	3338	17	292	1
A231	3X	D	12	S	A 4 K	294	3338	17	292	1
A231	3XB		10	P	A 4 M	294	3261	17	292	1
A231	4XB		1	S	A 2 R	402	2826	17	292	1
A231	4X	D	1	S	A 4 G	402	2345	17	292	1
A231	4X	D	1	S	A 4 G	402	2345	17	292	1

In the event of there being any overage, shortage or damaged material an O. S. and D. report is made out and sent to the production department, which follows the matter through the accounting department or fabrication department according to the nature of the difficulty, to straighten out the matter immediately.

The salmon colored and white cards are adjusted accordingly. The white cards are then mechanically sorted out of the in-transit file by the car number, and are assigned to the appropriate hulls as a basis for available material, which is part of the production-planning system, Fig. 8.

SHIPPING LIST

RUSH

American International Shipbuilding Corporation, Agent, United States Shipping Board Emergency Fleet Corporation

MAIL ON DAY OF SHIPMENT TO HOG ISLAND, PA.
NEVER ENTER MORE THAN ONE CARLOAD TO A SHEET

1st 25 A | 2d 25 A | 1st 35 B | 2d 35 B

A.I.S.C. Shipment No. 185 | Shipper's Order No. S.44. S.44. Change 1 | Ship No. 3 | August 6, 1919.

Name of Shipper: Dominion Bridge Company, Limited. Lachine, Que.

Consigned to: U.S.S.Board Emergency Fleet Corp. Shipped to: Hog Island, Pa.

Car No. and Initials: P&R 20357 | Trailer Car No. and Initials: | Via: GTR.Via Susquehanna Bridge LV & P&R

IMPORTANT NOTICE. MAKE SHIPPING LIST IN THE ORDER IN WHICH ITEMS ARE LOADED. THIS IS NECESSARY IN ORDER THAT THE STEEL YARD MAY HAVE PROPER UNLOADING INFORMATION.

Shipper's Mark No.	No. of Pieces	Piece Mark Complete as Marked on Steel.	Class	Title	Dimensions	Weights
1	9	2-A-24½ 36	1V	Thrust Recess Plates	13'4	8,310
2	10	2-A-23½-3 x E.S.B.	1B	Upper Deck Plates	27'7	43,140
3	7	" x E.S.P.	"	" " "	"	30,350
4	1	2-A-24½ 35	1V	Thrust Recess Plates	13'4	1,500
5	3	2-A-23½-3xE.S.P.	1B	Upper Deck Plates	27'7	12,940
19		x				
20		x				
C	30	TOTALS TO CONFORM TO B/L				96,240

DATE MAILED _____ A.M. P.M. SIGNED _____

FIG. 5. SHIPPING LIST FOR FABRICATOR

SHIPPER NUMBER 6

INDEX OF SHIPMENT FROM ADDRESS Emerson-Brantingham Co. Waynesboro, Pa.

SHIP'T NO.	DATE SHIPPED	TELEG. ADVICE	SHIPPING RECORD	DESCRIPTION	CAR NUMBER	CAR INITIAL	DATE REC'D	WEIGHT	MFG. SHIP GROUP
1	2/14/18			Floors & Bilge	277113	P.R.R.	3/10/18	37338	1A
2	2/21/18			" " "	55479	M. C. & St. P.	3/27/18	39610	1A
3	2/26/18			Open Floors	322644	P.R.R.	3/4/18	38870	1A
4	3/5/18			" "	855057	P. F.	3/12/18	40896	1A
5	3/4/18			Open Floors	17299	T. & O. C.	3/10/18	38964	1A
6	3/4/18			" "	38250	M. & St. L.	3/14/18	37664	1A
7	3/15/18			Bilge & Keel Bars	40369	T. & O. C.	3/29/18	44975	1A
8	3/21/18			" " "	11734	M. & O.	3/26/18	4863	1A
9	3/26/18			Open Floors	104970	A. C. L.	4/9/18	37488	1A
10	3/29/18			" "	2266	Fruit X	4/3/18	37400	1A

FIG. 6. ENTRY IN SHIPPING REGISTRY

After these cards are sorted by hulls they are tabulated by each hull, and this tabulation is forwarded to the local shipway administration building. The local production man at that building removes the green cards from the original file, which is called the unavailable file, and files the same in an available file for the purpose of requisitioning material. The white cards at the central office of the production department are then filed in alphabetical-numerical sequence in a file known as the stores-control file. All cards in this file represent the material on hand in stores. The inactive file, which

A.S.S.C. NO. 28-201 CAR NOS. & INITS. P.R.R. 278346
SHIPPED VIA DATE 8-5-18
SHIPPER Mt. Vernon Bridge Co.
TOWN Mt. Vernon, O.
CONTENTS Plates - Bulkhead
NO. OF ITEMS 15 CARDS TO COME WEIGHT 75625
DATE RECEIVED O. S. & D.

FIG. 7. ENVELOPE FOR PERFORATED CARDS

contains both the white and salmon colored cards, represents the unshipped material.

The ship erection is practically governed by available material, and from the available material the actual requisitions for delivery to the shipways are planned. For each piece to be requisitioned the corresponding green card is removed from the available-material file, the same being arranged in four separate groups by crane positions. Each group is placed in a Powers tabulator located at the ways administration building, and a requisition is then printed by the tabulator, which lists the mark, yard location, crane position and weight of each piece.

At the same time the weight is automatically totaled,

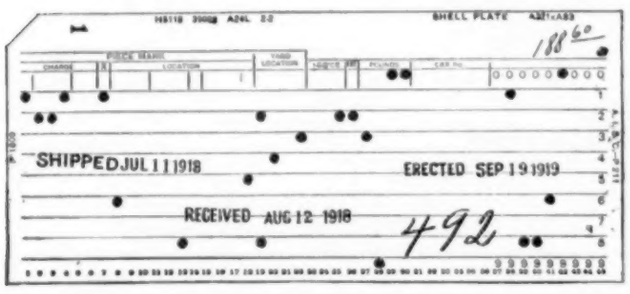


FIG. 8. CARD WITH RECORD DATES ENTERED

showing the weight of all material covered by the said requisition. The track, way and hull numbers are then printed in at the top of the requisition. Three copies are forwarded to the steel yard and two to the central office of the production department, Fig. 9. This requisition serves not only as a demand for material, but shows the loading arrangement, location of each piece and total weight, all of which are recorded for the benefit of the stores department. As soon as the requisition is received by the steel yard a salmon colored card for each piece of material requisitioned is removed from the material-in-stock file, rubber-stamped with the date filled, checked against the requisition and filed in a dead file. One copy of the requisition goes forward with the car to the point of delivery for checking material received.

When the central office of the production department receives its copies of the requisition one card for each

A STEEL YARD SHIP MATERIAL ORDER No. 223
Date Issued 8/23 Time Received
Time Issued 11:6 am For HULL No. 492 WAY No. 1 SECTION No. 4
TIME WANTED 8/24 Loaded By Started Finished Locomotive Crane No. Car Number

LOAD READING DOWN

MARK	YARD LOCATION SEQUENCE AND SECTION	REF. NO.	POUNDS
A241 XA 1 160S	A14E 134	1	792
A241 XA 2 160P	A14E 134	2	1247
A241 XB 1 160S	A14E 134	3	1641
A241 XB 2 160P	A14E 134	4	904
A241 X 1 160CL	A14E 134	5	199
A241 X 2 160P	A14E 134	6	200
A241 X 2 160S	A14E 134	7	200
A241 X 3 160P	A14E 134	8	199
A241 X 3 160S	A14E 134	9	220
A241 X 4 160P	A14E 134	10	243
A241 X 4 160S	A14E 134	11	192
A241 X 5 160S	A14E 134	12	214

FIG. 9. SHIP-MATERIAL ORDER

piece covered by the requisition is removed from the stores-control file and filed in a dead file by hulls, according to the hull number which appears at the top of the requisition. When the material is received at the shipyard it is checked off against a copy of the same requisition, and any shortages or errors are taken up with the store yard immediately and straightened out.

The green cards from which the requisition was written are filed in a file representing material ordered for erection by hulls. As fast as it is erected on the ship the cards are removed from this file, tabulated in triplicate and filed in a dead file. The tabulations represent a day's erection, showing the record of all pieces, weights and the cost of the material erected, as in Table II. These costs can be forwarded to the accounting department daily, weekly or monthly.

The tabulated record creates a daily historical record for each ship, showing the amount of material erected each day, the tonnage erected and the cost of the same. This information is of infinite value for future purposes

of comparison with each ship, comparisons of tonnage, costs, etc.

It can be readily seen, as far as the fabricated steel is concerned, that the method accomplishes the following results:

1. All clerical entries regarding material are mechanically written the same every time the occasion requires.
2. The necessity of keeping a stock ledger in the stores department is eliminated.
3. The necessity of making out a receiving report of material received is also eliminated.
4. A complete master control record in detail is kept and is available at all times, which has a record of all unshipped steel, all steel in transit, all steel in stores and all steel delivered, arranged according to the ship to which the said steel was furnished.
5. The stores department has a record of all steel received, on hand and all steel delivered.
6. The shipway has a record of all steel necessary to complete the ship, all steel available, all steel requisitioned, delivered and erected.
7. The accounting department can have available a record of all steel received, including weights by carloads, a record of all steel delivered out of the store yards, if necessary, showing costs, and a record of all steel erected, showing costs.
8. The possibility of human error is reduced to a minimum, for the reason that every time a card is used a tabulated record is made which proves the accuracy of handling the right cards.
9. The bulk of the operating routine can be performed by girls.
10. The amount of clerical help necessary to operate the system is only a small part of the number of hands required to operate the scope of the work as ordinarily performed.

Liners and rivets are considered as bulk stores, and for the sake of operating convenience they will be carried in sufficient quantities at every shipway to meet the immediate demands. They will be under the charge of the head liner man. They will be requisitioned out of the main store yard in bulk quantities. Powers cards are prepared in the manner described above for each bulk unit, for the purpose of requisitioning the material out of stores to the shipways. The estimated cost of the quantity included in such a bulk unit will be cut into the card. The shipment of this class of material from fabricators will be in approximately the same bulk units that they will be disposed, therefore the method of handling is practically the same as handling ship steel.

The method of handling machinery, fittings and equipment is practically the same as handling ship steel in that a set of Powers cards is made out for every piece of machinery or equipment that has a piece mark. They will be fitted into the erection sequence and handled in practically the same way all through as the ship steel.

In the case of some of the piping the distribution of the piping will be handled as a piping system, and a Powers card or a series of cards will be used to cover a system conforming to a predetermined bill of material of each piece that makes up a system. A record of this bill of material will be on hand at both the storehouse and shipways, so that when the requisition is received, by referring to the detailed bill of material, each item can be checked both for distribution from the storehouse and receipt at the shipways. This will closely conform to the catalog of ship equipment which has been prepared by the material engineering department, as in Fig. 10.

The material-control system here described does not

TABLE II. EXTRACTS OF DAY'S ERECTION

PIECE MARK				YARD LOCATION	SEQ	S E C	POUNDS		COST
A221 XA		2	S	A24 M	2	1	3160		16498
							3160	COST OF MATERIAL SECTION 1.	16498
A221 X C		4	S	A24H	2	2	1925		10500
A221 X C		52	P	A24H	2	2	1925		10500
A221 X C		52	S	A24H	2	2	1852		10243
A221 X	E	5	S	A24D	2	2	1852		10243
A251 3X		41	P	A18 L	4	2	1852		10243
A251 3X		42	P	A20 Q	4	2	1852		10243
A251 3X		43	P	A18 L	4	2	1852		10243
A251 3X		44	P	A20 P	4	2	1925		10500
A251 3X		45	P	A18 L	4	2	1925		10500
A251 3X		48	S	A18 L	4	2	1852		10243
A251 3X		46	P	A20 P	4	2	3020		16308
A251 3X		46	S	A20 P	4	2	3020		16308
							144682	COST OF MATERIAL SECTION 2.	770688
							3440		17960
							1963		10857
							1645		8646
							1638		8609
							1638		8609
							2002		11073
							2002		11073
							1619		8509
							1599		8404
							2124		11470
							143226	COST OF MATERIAL SECTION 3.	773380
							3540		18482
							3590		18743
							2767		19683
							2767		14447
							2767		14447
							15431	COST OF MATERIAL SECTION 4.	85802

CERTIFIED CORRECT J. R. Welsh

CLASS "A" SHIP MACHINERY AND EQUIPMENT J 35

58 FUEL OIL SERVICE FUEL OIL SERVICE 58

ITEM NO.	MARK	DRAWING NUMBER	PIECES OR FEET PER SHIP	DESCRIPTION	STORAGE SPACE REQUIRED WORK	YARD	SECTION
1	P.O.S-6507 (A 58 x 276) Stock List F 134	56896	4	1"Compo Female Screw Globe Stop Valves (Drain from Aft. Manifold)	20		
3	P.O.S-6507 (A 58 x 277) Stock List F 134	56896	1	1"Compo Female Screw Globe Stop Valve (Drain from Forward Manifold)	20		
5	P.O.S-6507 (A 58 x 278) Stock List F 134	56896	1	1"Compo Female Screw Globe Stop Valve (Drain from Manifolds)	20		
7	P.O.S-6507 (A 58 x 279) Stock List F 134	56896	1	1" Compo Female Screw Globe Stop Valve (By-Pass from Manifolds)	20		
9	P.O.S-6507 (A 58 x 280) Stock List F 91	56896	1	2" Compo Female Screw Globe Stop Valve Outlet from Inspection Tank	20		
11	P.O.S-6507 (A 58 x 281) Stock List F 455	56896	1	3/4"Compo Female Screw Globe Stop Valve Drain from Inspection Tank	20		

FIG. 10. LIST OF EQUIPMENT

provide for handling raw materials which are to be fabricated nor general supplies which are used in the maintenance of the shipyard. It covers only finished material as it is completed in the shops.

If the system is to be adapted to a yard manufacturing all of its own material it would necessarily have to be arranged in such a way that the system would start with the orders placed in the shops for manufacture of material.

Cost of Making a Pair of Offset Centers for a Crankshaft

By W. D. Forbes

Some time ago it was suggested in the columns of the *American Machinist* that the value to the readers of a published article would be enhanced if the cost of the described construction or operation was given. The following description of the manner of making a pair of offset centers for turning the crankshaft of a small engine includes this detail.

Estimating the cost of machine work can be done exactly if the estimator knows the men in the shop, the equipment, and the machines and tools available. No two shops will turn out a piece of work in exactly the same way or in the same time. The time given in this article is taken from the time cards of the shop where the work was done, and is therefore not an estimate but it would be interesting to get the opinions of readers in regard to the job, the time taken, and to the design of the centers or, as they are sometimes called, the throws. The time taken includes getting necessary tools from the crib and returning them. The time taken to make the drawings is considered as part of the overhead.

Description of the Work

The crankshafts to be finished with these centers were for an engine of 5-in. stroke, and the diameter of the shaft was 2¼ in. in the rough. A roughing cut was taken on the runs and each end was finished to $2\frac{1}{16}$ in. in diameter for a length of 2½ in. These finished ends determined the size of the holes in the throws.

A piece of bar steel 2½ x 4 in. was cut to a length of 14 in. This operation was not charged in the work cost, as it was done in the stockroom in a power saw, and the cutting off of all stock is considered as included in the overhead charges. The bar from which the piece was cut had been cut before, therefore both ends were fair. The blueprint required that a good planing cut be roughed off both sides and edges and a smoothing cut taken. The finish thickness was not material.

The first operation was drilling a hole 1¼ in. deep in each end for a $\frac{9}{16}$-in. tap. These holes, before tapping, provided a grip for the finger straps by means of which the piece was held to the bed of the planing machine. This would have allowed the machining of one face and the two edges at one setting, but the planing-machine hand did not do the work that way. He roughed both sides, and after testing to see if the piece had sprung, took a smoothing cut and then planed one edge with a down feed. Testing this with a try square and finding it all right, he set the piece on edge, the planed edge being down, of course, and roughed the upper edge and finished it. Then, reversing the piece, he took a finishing cut. In so doing he gained time.

The machinist who had drilled the end holes laid out two centers at the drilled ends equidistant from the two edges and the ends, and center-punched them. These centers he drilled with a No. 40 drill on a sensitive drilling machine and on a larger machine he enlarged these small holes with a 2-in. drill. The small holes saved circling and drawing. He also laid off a line halving the piece in length, and it was parted along this line in the stockroom, no time charge being made.

Next the boring-mill hand set the two pieces up so that the 2-in. holes registered, and bored them out to $2\frac{1}{16}$ in., bringing the holes to exact size. Then setting the platen over 2½ in. by means of the screw, which of course was fitted with a micrometer dial, he drilled a $\frac{15}{16}$-in. hole through both plates and bored this out to 1 inch.

The two pieces were laid together on a slotting machine and a score was slotted ¾ in. wide and $\frac{1}{16}$ in. deep in the large holes on the side toward the drilled ends. These scores thus cut into the end holes were for two purposes—to allow a piece of brass to be placed in them so that the end of the setscrews binding the shaft would not bruise it, and to allow the shaft to be got out easily, if they did. The end holes were then tapped for setscrews.

The next step was to file the edges, dress the ends and mark the pieces. Not marking or stamping a job was a serious offense in that shop.

The tool-steel centers were got out this way: Round tool steel 1¼ in. in diameter was used, being cut to 3½ in. long and centered. The ends were turned down to fit the 1-in. holes in the throws. A space in the center ½ in. long was turned to $1\frac{1}{16}$ in. and the piece parted in the middle. The pieces were then taken to a lathe with a draw-in chuck, the heads faced off to a thickness of ⅛ in. and a center drilled and reamed in each. These center plugs were then hardened and the centers lapped out, after which they were forced into their holes and the job was done.

The time taken was: planing, 2 hours 45 minutes; boring, 1 hour 30 minutes; vise, 5 hours 30 minutes; lathe, 3 hours 15 minutes. Total time, 13 hours.

Vise Work Covered laying Out, Drilling, Tapping, Slotting, Etc.

The vise work covered laying out, drilling, tapping, slotting, marking, finishing the ends—which were left rather rough by the saw cut—and rounding the corners and edges. In the shop where the work was done, the boring bars were not the usual lot to be found kicking about the mill, with all sizes of holes in them and a lot of unmarked cutters in a cigar box requiring more time to pick out than to do the boring, but the bars were kept in the toolroom, the cutters were all in position, and they would cut to size without trial. It was part of the tool-keeper's job to keep them so.

I do not know whether or not the rail of the planing machine was the top of the housing and had to be lowered into position, or if the boring-mill table had to be greatly shifted, but I *do* know that all tools were well supplied with bolts, angle plates and other required appliances, and that they were all kept in good order. It would be interesting I think if the readers of the *American Machinist* would tell what they think of the time taken on this job.

Solving the Labor Problem

By K. H. CONDIT
Associate Editor *American Machinist*

Sixteen years ago an attempt was made to solve the labor problem by applying common sense and democratic principles to one very bad case. The marked success of the experiment should have pointed the way to further trials, but little was done until the last few months when steps, which are promising to say the least, have been taken in a number of plants.

THE possibility of solving the labor problem has looked for some time about as likely as the chances of squaring the circle, although the problem is not so ancient. Investigations of available sources of information show several well-defined schemes, or systems, which have arisen at various times in the last forty years, had their vogue and either fallen from esteem or disappeared completely.

Among the many sincere and hard-working pioneers in the field of "Industrial Relations," as we call it just now, is H. F. J. Porter, M. E. His work is especially interesting, as it was an early application of the principles which are now regarded as being most likely to provide a real solution. The man who can point to successful practical applications of his theories is entitled to consideration when he presents his side of an argument, and Mr. Porter can do just that. His early work at the plants of the Nernst Lamp Co. and the Nelson Valve Co., and lately for the Hercules Powder Co., has attracted a good deal of attention. He seems to have discovered the germ which later showed such remarkable development, as early as the middle eighties, when he was superintendent of grounds and buildings at Columbia University. At that time he instituted the custom of weekly meetings of his janitors and the men responsible for the various maintenance jobs under his direction. At these meetings the men were encouraged to make suggestions for all sorts of improvements and to discuss them. Interest was further stimulated by sending one man off each week for a half-day inspection trip to some building or factory to see how the other fellow did it and report back to the next meeting.

The First Committee System

In 1903 Mr. Porter was called in to reorganize a Pennsylvania concern which was most emphatically on the rocks. About half the employees were women and the moral conditions were just about as bad as they could be. The product was so poor that it had twice failed of a market under the old management and methods, and no self-respecting salesman would touch it. An account of the rejuvenation of the concern which resulted in an 800 per cent. increase in sales in 18 months is given by Mr. Porter in an article called "The 'Get Together' Principle in a Factory Organization," in the *American Machinist* for Sept. 28, 1905. As to the proposition in general he says:

Having been called upon to reorganize the business, the "get together" policy was here instituted to a fuller extent than I had previously attempted. Each employee, as soon as he was engaged, was fully and carefully instructed in the details of his duties and was requested to inquire at once regarding any matter which might arise about which he was uncertain. He also had the importance of his duties, no matter how insignificant they appeared to be, impressed upon him, with the statement that if they had not been of sufficient importance to be performed, and in the right manner, he would not have been employed to do them. He was then instructed to exert his originative powers regarding improvements in his work as his experience might suggest, with the injunction that he would be expected to bring the results of his reflections to conferences of his peers which would be held at stated intervals.

As the result of the working out of this policy, the product was perfected so as to be satisfactory to the purchasing public, the processes of manufacture were simplified, their cost correspondingly reduced, and the company was put upon a paying basis within a very few months, so that at the end of the fiscal year it realized a fair return upon the capital invested.

He takes up some of the actual details of the plan as it was put into operation in the following paragraphs:

In the first place, a chart was evolved for the purpose of locating every individual in the company in his proper place and of letting each one see exactly where everyone else stood relatively to himself. A chart of this kind is invaluable in every well-organized establishment, and after it is made and posted throughout the works there is never any misunderstanding as to definition of authority and responsibility, it being understood that the possession of one of these requirements always entails the accompaniment of the other.

In order to introduce such a system into an organization whose intelligence had not previously been realized or recognized by the management, it became necessary to bring all the individuals concerned to a thorough understanding of what the management had in mind and to enlist their confidence and interest in the proposed plan.

To bring about these conditions, a meeting of all the employees of the company was called to take place one day at noon, and there I announced the desire of the company to change its policy of management to one in which all the employees should have a voice. The employees were requested to elect a factory committee, with representatives from the office, the selling organization, the factory operatives and the foremen. Of this committee the superintendent, representing the management, would be permanent chairman, while the term of service of each of the other members would be six months, so arranged that one member would retire and a new one take his place every month. This committee would act in a recommendatory manner to the management on all matters which would come automatically to it through a suggestion system as follows:

1. The Collection of Suggestions.—The employees were privileged to suggest any improvement of product, process or method which they might devise; also to recommend improvements in their working conditions or for their comfort. Questions of wages or of fairness of treatment by their foremen were first to be brought to the attention of the superintendent. All communications were to be signed and dropped into locked boxes, one of which was placed in the office and one in each department of the factory, and collections were to be made periodically by a confidential correspondence clerk in the main office, who would give to each communication a number, and file it for future reference. A copy without the writer's name was to be sent to the factory committee, which, unaware of the personality of its authorship, would pass upon it purely upon its merits and the author would be advised of its disposal through the minutes of the committee meetings, which would be posted on the official bulletin boards in the office and factory and supplied to the sales offices about the country through the columns of a typewritten "Journal," which

daily informed everyone in the organization regarding the principal occurrences of interest in the company. Such suggestions as could not be passed upon promptly by the committee would be referred, with a request for a report on their practicability, to the department which they affected.

2. The Reference of Suggestions for Departmental Report.—Each foreman was instructed to call the employees in his department together, for a few moments, at closing time once a week, to consider such suggestions as might be referred to him by the factory committee, and further to discuss any ideas which might be raised at the time leading to improvement in facilities for doing work or in comfort and conditions.

3. Further Conference on Suggestions Before Recommendation.—The superintendent was instructed to have the various foremen meet in his office every Saturday afternoon after closing time to talk over such matters as had been considered at their departmental meetings, above mentioned, and also to discuss questions of factory management, as well as to devise ways of working more closely together.

4. Final Recommendation Regarding Suggestions.—The superintendent would then report, at the next weekly factory committee meeting on Tuesday morning, regarding the various suggestions which had been referred to the departments under his control. All suggestions which were approved of as worthy of adoption were referred to the general manager with a recommendation to that effect. A schedule of awards for suggestions was formulated to induce their production and in payment for value received.

5. Decision Regarding Suggestions. — Every Wednesday afternoon representatives of the sales, development, production and financial departments came together at a "factory staff" meeting to discuss and finally pass upon the suggestions favorably reported to the general manager by the factory committee. This meeting also considered general complaints received from the public through the salesmen regarding the product, and to devise ways and means of overcoming troubles and improving designs. Such of the latter as required expert consideration were referred to the factory committee, to be handled in routine form.

The account goes on to tell of the daily, weekly and monthly meetings of various committees of the organization and the schedule of conferences between the manager and the individual department heads which insured his close touch with everything that transpired.

This particular case has been given in some detail because so many of its features have been included in the recent schemes and heralded, in some cases, as great discoveries. Remember, this happened 16 years ago. The recent discoveries are not so much discoveries of methods as they are discoveries of men and companies willing to try them out fairly.

Reorganizing a Philadelphia Plant

Several years later Mr. Porter was called to undertake a similar reorganization of a plant near Philadelphia. In this instance the conditions were equally bad but the circumstances were quite different. A striking account of them appears at some length in *The Outlook* for Mar. 13, 1909. In brief, the case was something like this: The owner had taken over the business which had involved a relative of his in its failure at another place and had moved it to an unproductive piece of property near his own estate in a suburban community which fiercely resented the invasion. He was not a manufacturer and had little interest in the concern so long as it managed to pay expenses. His lack of interest was soon mirrored by a similar attitude on the part of his men, and the plant which had started in a second-hand building with insufficient lighting facilities, with its second-hand machinery and with the additional handicap of being over a mile from the nearest means of transportation, went from bad to worse. The good mechanics soon went elsewhere and it became a haven for "floaters" and earned the name of a "mean shop." The supervision was so lax that some of the men were able to spend almost as much of their working day in a nearby saloon as they did in the factory. The effect on the product can be imagined. It was a situation to daunt any new manager.

It was necessary to make haste slowly and various devices of purely local value were employed to spruce up the shop and induce promptness. Then a "get together" scheme very similar to that employed in the case which we have just taken up was introduced with equally gratifying results.

Results of the Experiment

Dr. Richard Moldenke, then secretary of the American Foundrymen's Association, had an opportunity to observe the results of the new system and to sit in on one of the committee meetings. He gives a brief account of it on page 197 of the transactions of the above society for 1908 and concludes with this statement as to the results obtained by Mr. Porter:

> It may be remarked that the manufacturing concern in question from being a nuisance to its community before this system of "get together" was applied, became a factor for good thereafter. The organization was increased 100 per cent. in six months, and sales and profits went up proportionally. It was simply a good example of shop organization along advanced lines.

In commenting on the secretary's article Mr. Porter had this to say:

> One of the best evidences of a change for the better in the character of the working force was the growth of permanency in its personnel.
>
> Before the effort at reorganization was begun it was with difficulty that good men could be secured to work in the shop. There had been a change of 20 per cent. per month, or 240 per cent. per year, in the working force for a long time. This loss was gradually lowered to 15 per cent., then to 12, and finally to 8, while the organization doubled in numbers. The stringent rule against drinking had much to do with this improvement, and this rule was proposed and enforced by the men themselves, who took an ever-increasing pride in their organization. It was the better class of workmen, together with the improved conditions and methods introduced, which made the place pay.

Present Status of the Work

These two cases are unique in that they were successful so far ahead of their time. Failure and ridicule are the usual portion of ideas of such unconventional although reasonable character. That they were ahead of their time is shown by data appearing in an appendix to a paper on "The Status of Industrial Relations" prepared for the Spring Meeting of the A. S. M. E., where the firms which have installed some form of representative shop committee plan are listed with the year in which it was begun. Of slightly over 100 firms named, only 15 introduced the system prior to 1918 and only 10 prior to 1917. Apparently war conditions had something to do with it and it seems likely that the equally serious situation at present will force an extension and amplification of the plan.

It is quite possible that more experiments would have been made during this period if the so-called "welfare work" had not seemed more attractive and somewhat less radical. It is regrettable but true that the average owner would rather act the benevolent despot and devote a small share of his profits to shower baths, libraries

and milk stations without giving his men any voice in the matter, than to give them some say on their working conditions and relinquish a part of the control of their destinies which he may or may not justly administer. But isn't it short-sighted? It is true that it takes less out of the profits and consequently looks like a better business proposition in dollars and cents, but it is also true that it adds nothing to the total production and to the total profits. And like most other things a factory either grows or dies; it does not stand still.

Welfare work looks well from the outside but the opinion of the workman who has been up against it is quite apt to be more fluent than elegant. The system still has its supporters, as it undoubtedly is attractive from the viewpoint of the giver, for, is it not more blessed to give than to receive? But to the fellow who sees the fat profits made and looks in vain for any increase in the contents of his pay envelope, the prospect is less alluring, much less. He is not the sort to be satisfied with sops, and as such he usually regards welfare work. He wants a square deal and he is convinced he is not getting it this way. Is he very far wrong?

The International Harvester Company's Scheme

A very convincing presentation of the case for representation of the worker was made by Arthur H. Young of the International Harvester Co. at the same session of the A. S. M. E. Everybody knows something about safety engineering and its achievements. The safety engineer soon realized his limitations and comprehended the fact that really satisfactory safety provisions must originate with the men who were doing the jobs. The formation of the safety committees followed and the reduction in preventable accidents, labor turnover and its consequent expense demonstrated the wisdom of the step. Here was concrete evidence of the value of employee coöperation and it was only logical to extend the scope of works committees to include other matters. The average mechanic was not left out when the brains of the world were distributed and he is quite capable of suggesting improvements on any device which he has a hand in making for he gets closer to it than any one else. The difficulty has been to make the man higher up realize the fact and to get him to take steps to take advantage of it.

This naturally brings us to the "suggestion box," which was really the idea with which Mr. Porter started and which later developed the representative committee. It is not sufficient to put up the box and a notice about it and wait for something to happen. Some idea of what is likely to occur may be gathered from an editorial in the *American Machinist* for Sept. 10, 1908. It said, in part:

> At the bottom of the plan was, we think, the basic idea, whether recognized or not, that a large proportion of the suggestions would prove to be useful and that their adoption with a substantial reward would lead to a spirit of coöperation and good will. Actual experience in some cases, at least, seems to be quite the opposite of the expectation. So far from most of the suggestions being good, the fact is that very few of them are good, while many of them are nothing more than ill-considered complaints. Under these circumstances the large majority of them must be rejected and this soon kills the interest in the plan among the working force.
>
> * * * * *
>
> Some again have had their enthusiasm cooled by the presence in the shop of one or more chronic suggesters, who are always suggesting impracticable things, and following up their suggestions with insistence and importunity in a manner which has led to little less than disgust on the part of all concerned. . . . The plan contains such large possibilities of usefulness that it is certainly a pity that malcontents and cranks should be able to destroy the usefulness and bring it into disrepute. We are very much afraid, however, that that is the fact, and that, admirable as the idea seems, the large hopes which many have felt for it must be seriously curtailed.

A letter by Mr. Porter in reply to this editorial was published in the issue of Oct. 29, 1908.

> I have been much interested in your editorial on page 392, "The Other Side of the Suggestion Box." That many such installations have failed totally and that others have been great disappointments to their advocates is undoubtedly true, but in every case "there is a reason," and it is surprising how many of these reasons are the same, viz., a misconception of the function of the system and consequently its improper application and method of operation.
>
> In the first place it must be remembered that the suggestion system is only one of a number of so-called "industrial betterment" features, all of which go together in the reorganization of a plant in changing the management from "one-man control" to more democratic methods. These methods were developed in Germany some 25 years ago. Some of our progressive manufacturers who were then beginning to make frequent trips abroad for the purpose of investigating foreign methods were not slow in taking cognizance of them nor in recognizing the economic principles underlying them, and after studying them carefully adopted them in their entirety in the shops in this country. The success attendant upon the operation of these installations developed a horde of imitators who, without investigation or thorough understanding of the functions of the separate features which were parts of them, adopted such of the latter as they took a fancy to, and instituted homemade applications as best they could. These are the suggestion system and other systems of similar purport which you refer to as having so signally failed.
>
> The suggestion system *per se* is all right in theory, and in practice, when properly operated, is an unqualified success as a developer of business and a money maker. Like any other system, however, when improperly installed and operated, it cannot help but be a failure.

An Example

Some time ago, when called upon to resuscitate a manufacturing concern which had failed, I reorganized the shop on modern lines and installed as part of the new organization the suggestion system. It was not many months before the business was on a paying basis. When I turned it back to the owners I told them that they would have to keep the organization as it was then constituted, if they wanted it to continue to progress. The old manager, however, told me plainly that he knew nothing about management along the lines I had introduced. He said he looked upon me as a business doctor called in to see a very sick patient. He said he considered the suggestion system and other similar features as excellent tonics which had served their purpose in reviving the business, but now that it was on its feet it would have to stand and go alone. I told him that the whole business had been modernized to meet present conditions and that if he attempted to alter the methods then in vogue it would be extremely hazardous.

He was of the "one-man control" school, however, a regular slave driver, and it did not take long before old methods began to replace the new. By the time the financial panic came it had again so run down that it went completely to pieces. He came to me again for assistance, but I told him the patient was a corpse this time and that I could not galvanize it back to life.

* * * * *

There is no trouble about making the suggestion system work when it has proper environment, but there is much more to it than a suggestion box, and it will require someone to give it just as much attention as is given to any other institution in the shop, and if it does not work right or stops working it will be because the man in charge is

negligent or does not understand its method of operation.

The old-school manager installs the suggestion system with the principle in mind which he always has applied to his organization, viz., to get out of it as much as he can and give as little as possible in return. He has probably learned after long schooling that he cannot get something for absolutely nothing, so having heard of the suggestion system he resolves to try to use it, to induce his people to give up ideas, and he can be depended upon to foozle things later about adopting them and paying for what he has to. No wonder such systems fail.

Fair Treatment Must Be Given

The new-school manager has been taught that human nature is the same the world over and that if he wants fair treatment from others he has got to give it himself. So he organizes his shop on a democratic basis giving his employees something to say in the nature of suggestions and lets them pass upon them through committees in a recommendatory way. There is a spirit of "get together" in this method of management and if anything does awry it is at once adjusted. The suggestion system *as a part of such a system* cannot fail to work.

The suggestion system is only a subdivision of the whole system of representative factory organization, but what has been brought out concerning it applies equally to the others. Any system of this sort will fail if the human element is missing. It will also fail the instant that the men are given reason to suspect that the management is no longer playing fair with them.

Present tendencies are clearly shown in the discussion on the A. S. M. E. paper previously mentioned. Prominent representatives from big concerns in all parts of the country wrote in telling either of successful applications of some form of the committee system or of personal experiences and opinions which vindicated the principles underlying it.

Serious emergencies are often the occasion for revolutionary changes in methods of thinking and doing. Most of us realize the danger of Bolshevism as the extreme form of social unrest but not all of us are ready to change our habits to meet it. When we are willing to broaden out and follow the path set by some of the best of our big and small manufacturers in this matter of giving our men a square deal, then may we expect to see the cloud vanish as rapidly as it formed. One student of industrial relations puts it bluntly—the owner has either got to give his men a voice in the factory management of their affairs or have them take it by force and the factory as well. This may be extreme; we sincerely hope it is, but it is worth thinking about.

Boring Spiders for Paper Mill Cylinders

By R. P. Deane

The boring bar illustrated on page 951, Vol. 50, of the *American Machinist* brings to mind one that I made some years ago to bore spiders for paper-mill cylinders.

Many readers may not be familiar with paper-mill machinery so a brief description of a cylinder may help them to understand the construction of the bar.

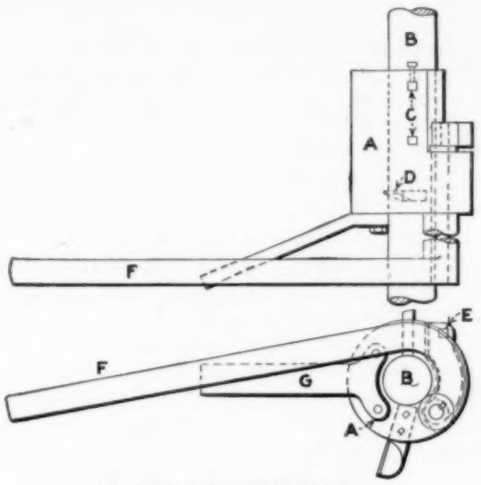
Paper-mill cylinders are built up by shrinking a number of brass spiders onto a cast-iron shaft. The spiders are from 2 to 4 ft. in diameter and are spaced 3 or 4 in. apart throughout a length of from 10 to 16 ft., according to the size of the machine. The end spiders, or "heads" as they are called, are a trifle larger in diameter than the rest of the spiders, and have ¼-in. holes drilled in the side of their rims near the periphery and parallel to their axis. These holes are about 1 in. apart.

All the other spiders have notches cut radially about their circumferences to match these drilled holes, and when all are shrunk onto the cast-iron shaft, which is hollow and about 6 in. in diameter, $\frac{5}{16}$-in. diameter round brass rods with the ends shouldered down to ¼ in. are put into place parallel to the shaft with their shouldered ends in the holes in each head while the bodies of the rods lie in the notches in the row of spiders.

The relative diameters of heads and spiders are such that the rods lie just flush with the surface of the latter, and after assembling the cylinder thus far, a shallow thread is cut upon the circumference of each spider, the tool of course nicking the rods, and then fine brass wire is wound in this thread, binding the whole tightly together.

Brass wire cloth is then stretched over this framework, the seam being neatly sewed with wire.

The boring bar mentioned above was made for the purpose of boring the hubs of the spiders which are 6



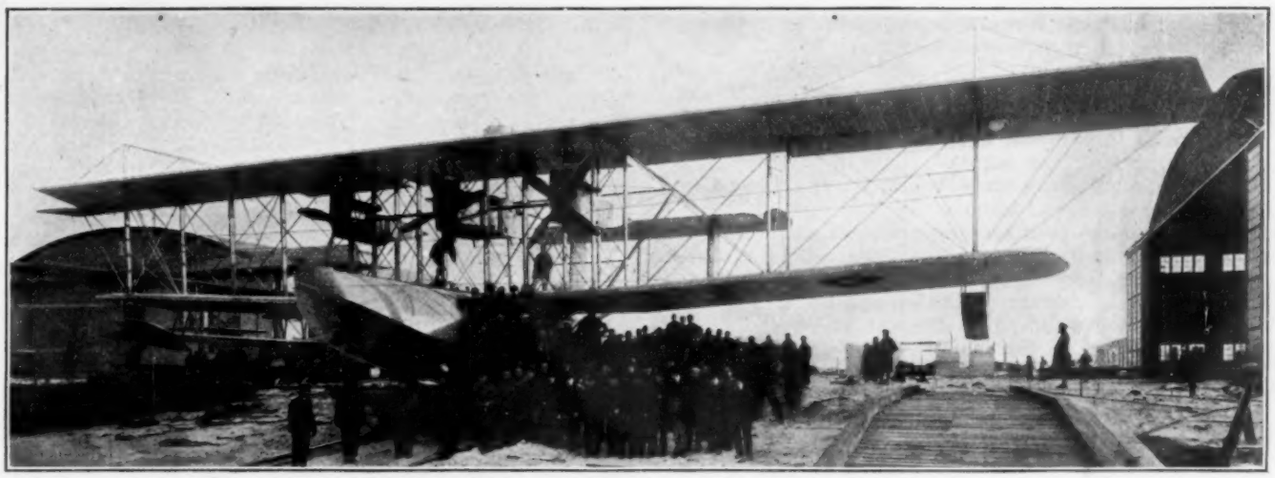
RIG FOR BORING HUBS

in. inside diameter and 2 in. long. The body *A* of the tool is of cast iron, and is made to slide on the harbor *B* which is held on centers in the lathe when in use. Two cutters *C*, one for roughing and one for finishing, are carried in the bar, being so spaced that the finishing cutter commences its cut just after the roughing cutter is through.

A side tool *D* squares the outer end of the hub. The body *A* is cut away to accommodate a swinging cutter *E* which is actuated by a lever *F*, and this cutter is so spaced with reference to *D* that when the latter has finished its work on the outside of the hub, cutter *E* is fed across the inner end by raising the lever *F*.

The spiders are swung up on a faceplate, being blocked out sufficiently to allow plenty of room for the boring bar to be operated. The arbor *B* is then put on centers and the shank *G* of the boring head clamped in the toolpost. The carriage feed is locked in and the tools fed through until cutter *D* finishes squaring the outer end of the hub.

The feed is then stopped and lever *F* raised, feeding the tool *E* across the inner end of the hub, thereby completing each piece in what is practically one operation.



Progress in Naval Aircraft—I*

By COMMANDER J. C. HUNSAKER
Bureau of Construction and Repair, Navy Department, Washington, D. C.

The transatlantic flights by flying boat, airplane and dirigible balloon have so absorbed public interest lately that an authoritative account of the development of the United States Navy's NC boats seems timely. The first part of this paper tells of the causes leading up to the building of these craft and gives some of the details of their design, construction and performance.

WITH aircraft, as with battleships, destroyers, and all men-of-war, the types used by the United States Navy have come to be known as distinctively American types, although the military problem solved by each type is usually not distinctively American. This result has to a large extent come about through a natural American prejudice against copying features of design and construction with which we are inexperienced. This prejudice is, of course, a stimulant to originality, but must be tempered by good judgment or good engineering, which is the same thing. A constructor, while he should very properly hesitate to copy practices he only half comprehends, must at the same time be quick to recognize the merits of a foreign development and to adapt or adopt its good features in his own work.

During the war the Navy selected only one foreign seaplane type to be copied in the United States. This was the British Admiralty's flying boat, F-5, plans of which were brought to the Naval Aircraft Factory early in 1918 when the factory was going in full production on the H-16 flying boat, a Curtiss development. Production was shifted over to the new model with considerable trouble and delay because it had a superior bomb capacity and air endurance. But as soon as a start was made to prepare the necessary production data for the factory and its subcontractors, it was realized that very material changes would have to be made. In fact, before the boat was finally got into production it resembled the British prototype only in externals. The changes made can be classified under these heads:

(1) Change of power plant installation from Rolls-Royce to Liberty, involving new oil, water and gasoline systems and starting arrangements;

(2) Change of design of all metal parts and fittings to permit use of American practice in metal-stamping machinery and to eliminate hand work;

(3) Change of design of all pins, nuts and bolts to American standards;

(4) Change of controls in boat from single to dual to meet demands of American flyers;

(5) Change from unbalanced to balanced ailerons to ease up load on the pilot;

(6) Change bomb racks, etc., for American equipment;

(7) Change of internal hull construction from British practice with ribs to American practice with longitudinal stringers;

(8) Substitute laminated struts and wing spars for solid types to save spruce;

(9) Change bottom planking and step construction to American practice;

(10) Change system of covering wings, using cotton instead of linen;

(11) Strengthen tail where it appeared weak;

(12) Remake all plans to permit quantity production of interchangeable parts assembled from a multitude of subcontractors.

The American theory of manufacture is to assemble parts produced from separate makers or departments if all are made in the same plant. To apply this theory of manufacture the design has to be prepared accordingly. Also we have American practices, standards and special materials to be looked out for. Some of these special practices and materials are common to both Army and Navy and represent industrial development, but a great many are peculiar to the Navy alone and have been arrived at as the result of experience or research.

The Navy with aircraft, as with ships, does the greater part of its own designing and building through its Corps of Naval Constructors. At the same time, private design and construction are encouraged by contracts with builders which lodge engineering control in Navy Department.

The NC flying boats, whose very recent transatlantic performance is too well known to be gone into here, represent a typical example of how the Navy operates on the engineering side. Their design and construction made use of available talent both in and out of the service, the facilities of parts makers and the new materials developed during the war, and, in general, represent the result of organized engineering rather than invention. For this reason no one man can be said to have designed these craft, although the Chief Constructor of the Navy, Admiral Taylor, was at all times responsible for ways and means and results as well as the initial conception of the project.

The NC flying boat is, as I say, typical of Naval practice, and in describing it I can give some idea why it is a distinctively American type and some account which may be interesting to engineers of any new processes and materials used.

In the same way the airship or dirigible C-5 is a distinctively American type, and while I regret that we did not succeed in crossing the Atlantic with it, the flight

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from Long Island to Newfoundland proved the possibilities from an engineer's point of view. It appears certain that had we set out with three airships, as we did with three flying boats, to make the "big hop across," at least one would have made it. The design and construction of the C-class airships made use of organized engineering, just as in the NC project, and in describing it I could cover the war-time development in airship construction of the Navy. However, to do so would make this paper too long and I shall confine myself to heavier-than-air craft.

The development of really large flying craft before 1917 was held back because no suitable engine had been designed. Several attempts, both at home and abroad, had resulted in failure, notably the Curtiss giant triplane and the Sikorski, both land machines. When the 350-hp. Rolls-Royce became available, the four-engine Handley-Page was brought out in England, but in the United States no American engine was in sight until about August, 1917, when the preliminary work on the Liberty began to look promising.

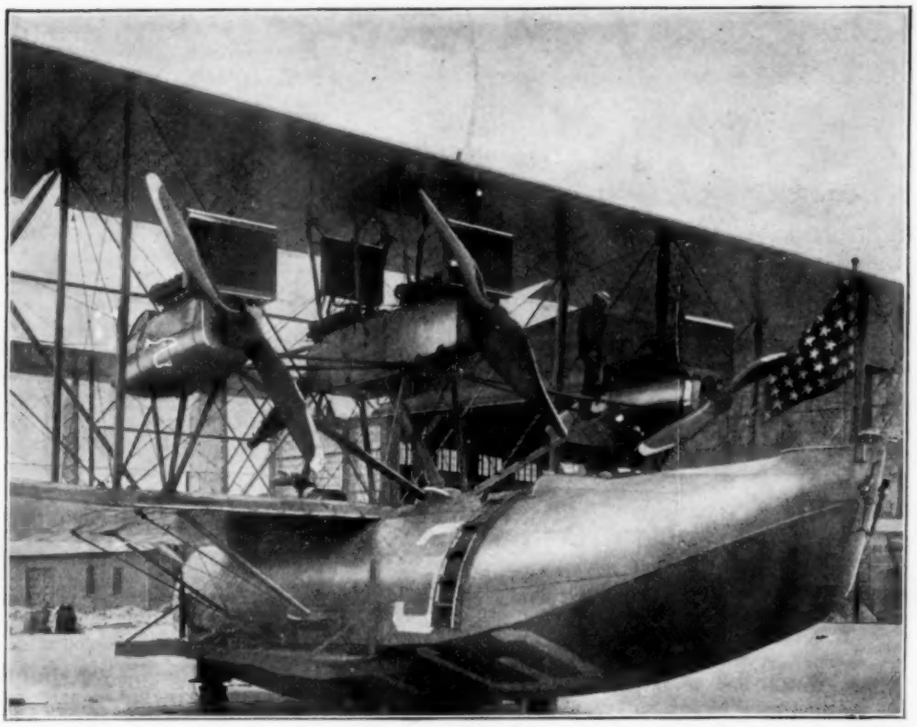


FIG. 1. THE NC-3 ON HER LAUNCHING CRADLE

Admiral Taylor, as a member of the Aircraft Board, was in a position to weigh the evidence as it came in and to foresee the ultimate success of the new engine. This engine, then known as the "United States Motor," was still under a cloud of unfavorable comment from foreign and domestic experts, but the early troubles were recognized as natural and inevitable and the chance of success looked good.

About this time the German submarines were extremely active and successful and there were grave doubts of there being shipping available to transport to Europe the great tonnage of American material necessary to prosecute the war. In particular, one of the weapons needed to keep down the submarine was the flying boat, and unless we had a great number of flying boats on patrol over the European submarine-infested areas the shipping space available would be rapidly diminished, and unless there was shipping space the flying boats could not get over. It was a vicious circle and could be broken only by flying the boats across the Atlantic under their own power. For 1918 we had a large program of flying boats which were indeed large, but not quite large enough to be flown safely across the Atlantic. In 1919 we needed something bigger, and to prepare for quantity production, the experimental models would have to be brought out in 1918.

The first step to provide the transatlantic boats was the following memorandum:

Washington, D. C.
Aug. 25, 1917.

From: D. W. Taylor, Chief Constructor, U. S. N.
To: J. C. Hunsaker, Naval Constructor, U. S. N.

The "United States Motor" gives good promise of being a success, and if we can push ahead on the airplane end, it seems to me the submarine menace could be abated, even if not destroyed, from the air. The ideal solution would be big flying boats or the equivalent, that would be able to keep the sea (not air) in any weather and also be able to fly across the Atlantic to avoid difficulties of delivery, etc.

Please think it over very carefully, particularly as to the method of procedure to develop something as close to the ideal as possible.

Design studies were at once put in hand and from time to time various men were called in consultation with the regular design staff of the Bureau of Construction and Repair. Ideas and suggestions from all sources were considered, and the design itself became a composite of ideas, these being chosen and incorporated into the design on the basis of suitability and merit and without any reference to their source.

Plans were then prepared in the Bureau for a boat of this character to be fitted with three engines and for one to be fitted with five engines. The predicted performance was computed for each boat from which it appeared that the three-eingine boat could be made to satisfy the general requirements of the problem and could be built much more quickly and with smaller risk of failure. Admiral Taylor accordingly directed that the design staff of the Bureau be put on the plans of the three-engine type. Investigations were at once undertaken to determine in a preliminary way the construction of wing beams, struts and the principal structural members, the proportions of wing area, fin and control surface areas and the materials to be employed for important parts. The general appearance of the design was worked out and the procedure to be followed in making the detail drawings established.

A 3-ft. model of the design was then made exactly to scale and tested by Dr. A. F. Zahm in the wind tunnel of the Washington Navy Yard. From his investigations of the forces of this model when held in a 70-mile-per-hour artificial wind, the size and arrangement of tail surfaces needed to guarantee stability and correct balance in flight were determined. With a machine of the unprecedented size contemplated, it was vitally necessary that there should be no doubt on this score, as an accident on the trial flights would set the project back many months besides risking the lives of the crew.

The design being worked upon was of dimensions far beyond any previous experience in this country, indicating that much unfamiliar territory would have to be covered. New methods of constuction would be required that the design might be successful, as, otherwise the weight of the design would increase with such rapidity as to make success impracticable. In the state of design information as it existed in the United States on that date, this necessity was one of the greatest seriousness and one which imposed upon the personnel connected with the design a great amount of investigation and experimentation in the working out of the details referred to.

It soon became apparent that the carrying on to the completion of design work of such dimensions at the Bureau of Construction and Repair in Washington would

be impracticable, unless the entire facilities of that Bureau were devoted to this work. Under the enormous pressure of air matters connected with the war which had devolved upon this Bureau, in common with the other bureaus of the Navy Department, this was impossible, and it was accordingly decided to arrange with the Curtiss Aëroplane and Motor Corporation, Buffalo, N. Y., to complete the drawings with their own design facilities, and with the contribution by themselves of such ideas of value as might develop under the control and supervision of the Bureau.

Completion of Design by Outside Organization

A contract was, therefore, made with the Curtiss company for the performance of this, the drafting and design work. Under the terms of this contract it was to carry out all work directed by the Navy Department, furnishing in connection therewith all facilities necessary. The Bureau of Construction and Repair reserved to itself the direction and oversight of all work coming under that Bureau and, for this purpose, placed in charge, as its field representative, Naval Constructor G. C. Westervelt, whose headquarters were at the plant of the Curtiss Aëroplane and Motor Corporation in Buffalo. Active work on the detail design was begun at Buffalo early in October. Shortly after the commencement, Naval Constructor H. C. Richardson was ordered for duty in connection with the design of the hull.

In carrying on the actual work of design, the design as a whole was first divided into its main elements. These main elements were designed or approved by the Bureau of Construction and Repair and the various details of these were then distributed to the members of the design force at Buffalo working upon them. All ideas, whether of the Curtiss company or of the Navy, were pooled, and as details were worked out the decision to accept them was made as a result of discussion.

The flying boats were designated NC, N for Navy and C for Curtiss, indicating the joint production of the Navy and the Curtiss Engineering Corporation. Being designed for war service, the boats are not at all freak machines put together to perform the single feat of a record-breaking flight, but are rugged and comfortable craft designed and built in accordance with standard Navy practice. The NC-1 was in service seven months and had rough handling when the new pilots for the other NC boats were trained on her but was in good condition to start for the Azores and, considered all round, was the best boat of the four.

The term flying boat is used for the NC type because it is actually a stout seaworthy boat that ploughs through rough water up to a speed of 60 miles per hour and then takes to the air and flies at a speed of over 90 miles per hour.

The hull or boat proper is 45 ft. long by 10 ft. beam. The bottom is a double-plank V with a single step somewhat similar in form to the standard Navy pontoon for smaller seaplanes. Five bulkheads divide the hull into six water-tight compartments with water-tight doors and a wing passage for access. The forward compartment has a cockpit for the lookout and navigator. In the next one are seated side by side the principal pilot or aviator, and his assistant. Next comes a compartment for the members of the crew off watch to rest or sleep. Aft of this there are two compartments containing the gasoline tanks where a mechanician is in attendance and finally a space for the radio man and his apparatus. The minimum crew consists of five men, but normally a relief crew would be carried in addition.

The hull, as shown in Fig. 1, is designed to have an easy flaring bow so that it can be driven through a seaway to get up the speed necessary to take the air and a strong V-bottom to cushion the shock of landing on the water. The combination of great strength to stand rough water with the light weight required of anything that flies was a delicate compromise, and it is believed that a remarkable result has been obtained in this design. The bare hull, as completed by the yacht builder and ready for the installation of equipment, weighs only 2800 lb., yet the displacement is 28,000 lb., or 0.1 lb. of boat per pound of displacement. This lightness of construction was attained by a careful selection and distribution of materials. The keel is of Sitka spruce, as is the planking. Longitudinal strength is given by two girders of spruce braced with steel wire. To guarantee water-tightness and yet keep the planking thin, there is a layer of muslin set in marine glue between the two plies of planking.

The lines of the hull mark an important advance in the design of planing bottoms. In the early flying boats it was considered necessary to have great width to make the boat plane at reasonably low speeds. A usual rule has been to allow not over 100 lb. of displacement per inch of width. Sometimes, to get more width of bottom, side fins or pontoons were built out from the main hull, as in the F-5, H-16 and HS-1. In the NC hull the radical step was made of getting planing by speed rather than by width. The NC boats at the start from Newfoundland got off with a 233-lb. load per inch of width of planing bottom. This is possible because of the easy lines of the after body which permit a speed on the water up to 65 mi. per hour. when all engines run at full speed. Running at this rate, it is very important that the pilot have control of the fore-and-aft attitude of the boat. This he can do by rocking the boat with his elevators. To permit such rocking while planing at high speed is a rather delicate design problem. With a two or more step hydroplaning bottom, the boat planes on at least two steps and hence is fixed in attitude so that there is nothing the pilot can do to change it. With a single deep step the boat gets up on this step and is quite unstable except for the air controls. Unless the pilot is expert he may get into difficulties, especially in a swell. The NC hull has a short distance back of the center of gravity a single deep step on which the boat can be rocked by the pilot after he gets up to planing speeds, but until sufficient speed is established to make the air controls effective, the stern of the boat is also planing on the water and acts somewhat as a second step to hold the boat in a reasonable attitude. The form of this stern is novel and constitutes an important improvement in the design of flying boats.

The tests of the model hull in the towing basin at the Washington Navy Yard showed that the boat got up to speed quickly if trimmed about 8 deg. by the stern. In practice the pilots have verified this "optimum trim" and at the start let the boat run at this designed or natural trim until it rises to the surface of the water and begins to plane. The trim is then reduced to 6 deg. to lessen the air resistance of the wings and keep down the lift so that the boat will stay on the water until the air speed meter indicates that flying speed is attained. When this rate is reached the pilot watches the sea and "waiting for a smooth time" pulls back the elevator column to increase the angle of incidence of his wings to about 15 deg., or a trim of boat of about 12 deg., to lift himself into the air. A feature of the NC hull is the ability to be pulled back in this manner and to keep on the water without "porpoising" until adequate speed is reached. Once in the air, it is necessary to stay there and not bounce back on the sea, subjecting the boat to abnormal shocks. Due to the pointed form of stern, when the pilot pulls up his elevators the point of the stern is pressed down into the water, thus increasing the trim.

The NC hull construction is peculiar to American Naval practice from the use of a longitudinal framing system developed from experience with pontoons for seaplanes. The boat is divided into water-tight compartments by transverse strength bulkheads of two-ply planking riveted together over a layer of cotton fabric set in marine glue. This construction had been found to be light, strong and to retain water-tightness even when distorted or strained due to the peculiar property of the marine glue of remaining soft and sticky. Such planking is our practice of bulkheads, inner and outer skins of boat hulls and wherever water-tightness is desired.

The object of the glue and fabric is to provide a waterproof film that will remain permanently flexible and sticky and at the same time seal up the holes made in the planking when the two layers are fastened together with innumerable brass or copper tacks. It was found soon after hostilities began that the type of marine glue which had

previously been used for this purpose was almost unobtainable, since it was all made abroad. The American production of this product was necessary and the Bureau of Construction and Repair established certain standards or requirements which have been successfully met by American manufacturers. The requirements of a satisfactory glue are many; for instance, it should be of a non-drying nature and must remain perfectly soft, flexible and sticky. If it contains too large a quantity of volatile solvent rapid drying will be effected and hardening of the glue will result, with consequent separation of the layer of planking. It must also be resistant to salt water and must not foam up and exude between the plies when subjected to long-time immersion. After the glue is applied a short time is allowed before the hull is painted. The varnish and enamel is then applied. Marine glues are usually composed of a mineral gum, shellac, pine tar, cellulose lacquer or rubber dissolved in the necessary solvents to the consistency of molasses.

running along at normal speed the boat practically flies herself in good air, requiring no work by the pilot. Naturally, in bumpy air the pilot has something to do, but due to the great inertia, bumps which would toss an ordinary machine about are barely felt. The boat is inherently stable to such a degree that if disturbed from normal flying attitude by any cause it will return to it without the intervention of the pilot. At the same time the controls are powerful enough to overcome the inherent stability so that the pilot is able to handle the boat in the usual manner. Naturally, in a boat of such size, quick maneuvering is not possible, and for this reason the usual factors of safety were cut down in a most radical manner. The results have justified the conclusions arrived at as to factors of safety based on purely theoretical considerations.

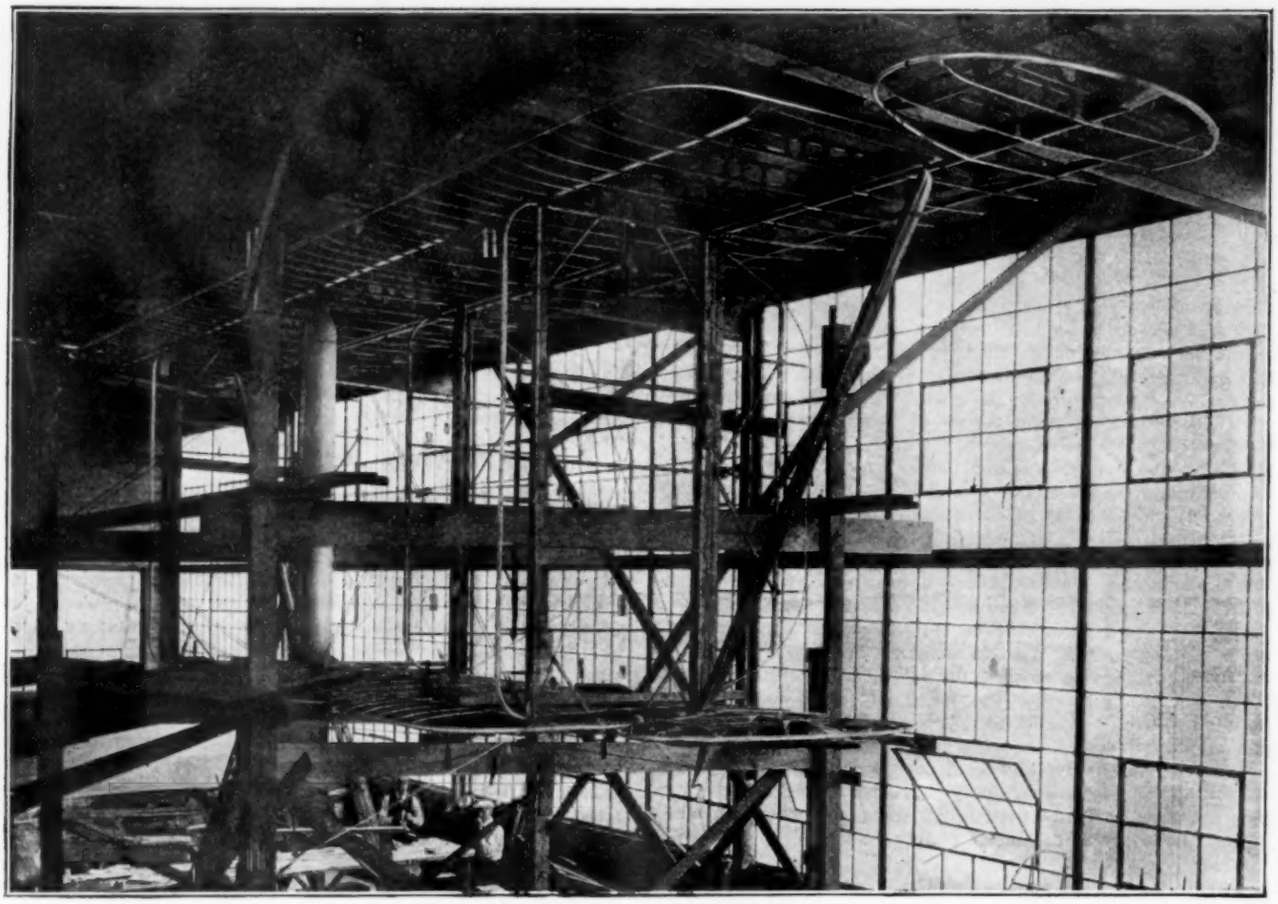


FIG. 2. CONSTRUCTION DETAILS OF TAIL SURFACES

The tail in the NC, shown under construction in Fig. 2, is unique and resembles no other flying machine or animal. The tail surfaces are made up as a biplane which resembles in general appearance and size the usual airplane. Indeed, this tail of over 500-sq.ft. area is twice as large as the single-seater fighting airplanes used by the Army. This tail structure is supported by three hollow spruce booms braced by steel cable in such a way as to remain clear of all breaking seas and to permit a machine gun to be fired straight aft from the stern compartment without interference. The method of support is a radical change from former American and foreign practice, but has resulted in several advantages besides an important saving in weight.

The tail surfaces were proportioned after extensive wind-tunnel tests at the Washington Navy Yard and the area and settings adjusted to give correct flying balance and inherent longitudinal stability. The horizontal stabilizers are inclined 1 deg. to the chord of the wings. This angle has been found on trial to give a very easy balance, and

To insure easy operation, each control surface was carefully balanced in accordance with experiments made in the wind tunnel on a model of it. The operating cables were run through ball-bearing pulleys and all avoidable friction eliminated. Finally, the entire craft was balanced so that the center of gravity of all weights came at the resultant center of lift of all lifting surfaces. There is provision, however, for an assistant to the pilot to relieve him in rough air if he becomes fatigued or wishes to leave his post to move about the boat. The matter of providing a servo-motor was at first thought worth going into, but on trials the controls were found to be so easy as to make it unnecessary to provide for power operation. A British type of servo-motor had, however, been imported and 50 units made and issued to the service for trial. Some of the twin-engine boats have been found heavier on controls than the NC and good results have been had using servo-motors on them.

The standard Navy practice is to design tail surfaces for a load of 20 lb. per square foot, but on the NC the horizontal stabilizer is designed to fail under a load of 13.5 lb. per square foot. The vertical fins are designed for 7 lb. per square foot load and the rudders and movable surfaces

for 10 lb. The main wing girder when loaded to 28,000 lb., the maximum permissible overload for start of the transatlantic flight, has a general factor of safety of 3, as against 6 for ordinary seaplanes and 8 to 12 for pursuit land types. No evidence of structural weakness has developed so far, but of course in designing for such low factors of safety the greatest care has been taken in the selection of material and the structural calculations.

In the last few years we have learned considerable about the mechanical properties of spruce and now use it with confidence where before we employed it only after prayerful consideration and the allowance of a very liberal factor of safety. In the NC spruce was used wherever possible for tail booms, wing spars, ribs, struts and internal hull work and wherever bending was unnecessary. Fig. 3 shows the construction of the wings.

The knowledge of the mechanical properties of spruce which we now have and which enables us to use straight engineering calculations, is due principally to three things: First, the research data of the Forest Products Laboratory; second, the experience of our own inspectors and builders in selecting sound and uniform timber; and third, the knowledge gained by experience which enables us to employ the wood in laminated and spliced form.

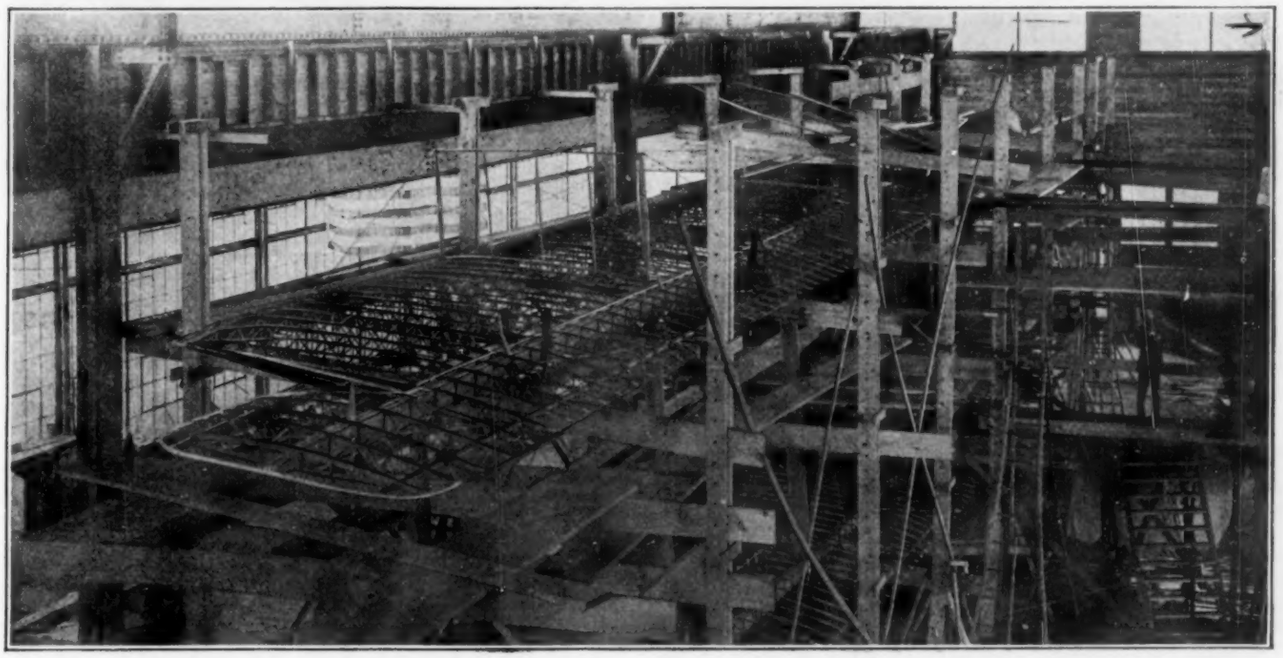


FIG. 3. THE MAIN WING SURFACES UNDER CONSTRUCTION

In the study of the effect of moisture content of wood it was found necessary to season it artificially in a dry kiln and to run the seasoning process as carefully as the heat-treatment of steel. The wood when seasoned should be sealed up at once by varnish to prevent warping and checking. In our usual quantity-manufacturing method, wood parts cannot be used at once and must be kept in stock a rather indefinite period before they are wanted in the assembly operation. It is not practicable to varnish many parts before assembly, especially where glue is to be used. A solution of the difficulty was found at the Naval Aircraft Factory, where humidity control of the air of the entire plant was incorporated in the heating and ventilating system. Such a system has been used in cotton mills, but is believed to be new in a woodworking or aircraft factory. The results have been most successful and fully justified the additional outlay. Wood parts cut to fit can be stored in the shop for a considerable period of time and when finally assembled go together perfectly.

The work of the Forest Products Laboratory has swept away the mystery which formerly surrounded attempts to use wood as a material of engineering construction. The relation between the density, moisture content and strength of the wood is now understood. The usual defects such as pin knots, spiral grain, etc., have been analyzed and their effects taken account of in establishing tolerance tables for any given design of plane. Naturally, for the NC where the factor of safety had been reduced to a minimum it was necessary to use absolutely clear, straight stock of correct density. To insure faultless material it is much easier to use laminated and spliced work where more thorough inspection of each part can be given.

The wings are of a curvature known from experience to be efficient, designated as R. A. F. 6, and carry a load of 11.7 lb per square foot in the air, but the structural weight is only 1.2 lb. per square foot. The total area is 2380 sq.ft. Wings of this size could not be constructed by the usual methods and materials without exceeding this figure considerably and a great amount of research and experiment has been necessary to determine the disposition of material to adopt.

The main wing spars are hollow spruce boxes. Each rib is a truss designed like a bridge consisting of continuous cap strips of spruce, corresponding to the upper and lower chords of a bridge truss, tied together by an internal web system of vertical or diagonal pieces of spruce. The ribs are 12 ft. long but only weigh 26 oz. each. On test these ribs were required to carry a proof load of 450 lb. of sand for 24 hr. without damage. An interesting detail of the wing construction is the hinged leading edge which incloses the control cables to the ailerons or wing flaps. This eliminates the air resistance of these cables, but at the same time they are accessible for inspection by merely swinging up the leading edge on its hinges. The wings are arranged as a biplane with the necessary struts and wires to give girder strength. For lightness the struts are made up as a spruce box, but to decrease resistance this square portion is inclosed in a fish-shaped fairing or "stream line" of stiff fiber. To reduce any tendency of the struts to bow under load, the middle points are connected with a steel cable. The diagonal bracing between wings is by steel cables in pairs. These cables are arranged to lie one behind the other with a spruce batten between to reduce air resistance.

The metal fittings, Fig. 4, where struts and wires are fastened to the wings presented a serious problem. The forces to be taken care of were so large that it was necessary to abandon the usual methods of the airplane builder and adopt those of the bridge designer. All forces acting at a joint pass through a common center. In this case, as in

a pin bridge, the forces are all applied to a large hollow bolt at the center of the wing beam. In the design of the metal fittings to reduce the amount of metal needed, it was decided to employ a special alloy steel of 150,000 lb. per square inch tensile strength. To increase bearing areas, bolts and pins are made of large diameter but hollow.

Guarding Against Corrosion

The steel work being highly stressed, it is especially necessary to protect it against salt-water corrosion. The development of the present Navy standard practice may be of interest at this place. At the start of the war aircraft fittings were copper plated and in some instances the copper plating was covered by nickel plating. If the plating became scratched or abraded, moisture and air were admitted and very rapid corrosion would ensue, the iron being electro-positive to the copper or nickel and thus forming a primary battery.

Recognizing the fact that zinc is a metal that is strongly electro-positive to iron, the Bureau decided to eliminate copper and nickel plating and to use in place thereof galvanized coatings produced either by the hot dip, electro-galvanizing or sherardizing processes. Metal thus treated, even when abraded, is protected from corrosion because of the strong electro-positive nature of the zinc, which has a high protective influence upon any adjacent areas of steel that may be uncoated or abraded. Since the hot-dip process operates at a high temperature, approximately 375 to 475 deg. C., it might injuriously affect certain types of heat-treated steel alloys and the electro-galvanizing method is used wherever possible and is required for all alloy steels. Through the assistance of the Bureau of Standards, a plating expert was obtained and sent to the different factories to install this process. After the parts are galvanized they are then coated with naval gray enamel, which is either air dried or baked on. It has been found that the enamel adheres well over the electro-galvanized part and a fitting is obtained which has given excellent results on exposure to salt water for a long period of time. This is considered a development of great importance since so much trouble has heretofore been had with improperly coated metal fittings.

Aluminum Used in the Construction

Aluminum is used to a considerable extent in the construction of aircraft instruments and it has been found that rather rapid corrosion of the aluminum may ensue when exposed along the seacoast. For this reason aluminum instruments have been coated usually with spar varnish, or naval gray enamel. The results obtained have been very good and it is probable that coatings of this type will be used in the construction of certain parts of the aluminum strength members of rigid airships. The Bureau has under way a series of exposure tests at different points along the coast to determine the resistance of various aluminum-alloy sheets to corrosion. There has been recently developed in this country at the request of this Bureau aluminum alloys which are of themselves highly resistant to atmospheric influences regardless of any coatings.

Various types of soldering flux and paste have been used in different aircraft contractors' plants. The largest use of these has been in the soldering of splice terminals on wire cables. It has been found that whenever certain of these soldering compounds are used, rapid corrosion of the cable occurs, as the compounds contain acid ingredients which work down into the strands. Examination of a great many samples of different types of soldering compound show in practically every instance a very large proportion, from 20 to 80 per cent., of zinc chloride, sometimes admixed with ammonium chloride or mineral oil. The purpose of the zinc chloride is to have present a material that would hydrolize to an acid reaction which would cleanse the surface of the metal by dissolving the oxides and make a good soldering surface.

It has been found that the use of such compounds can be done away with entirely, and one cause of corrosion eliminated by the use of a soldering flux free from mineral acid. The flux consists of rosin with an organic acid compound such as stearic acid, these two ingredients being melted together in equal quantities by weight. This material has practically no solvent effect upon metal but cleanses the surface sufficiently from the oxide to present a good soldering joint. Some slight difficulties were at first had with contractors who endeavored to make up their own soldering compound to the above formula, reports being to the effect that they did not get sufficient cutting effect with the compound. These instances, however, showed that they had purchased stearine in place of stearic acid. Stearine, as is well known, is a glycerine ester of stearic acid and has no acid value, being neutral. Stearic acid, on the other hand, has a high acid value of 200, and when used with rosin forms a soldering flux that gives very satisfactory results.

Besides protecting the metal parts, it is necessary to protect the wooden members and their glue joints. Ordinary paint is fairly satisfactory but too heavy. The common varnishes and shellacs are not water-tight enough.

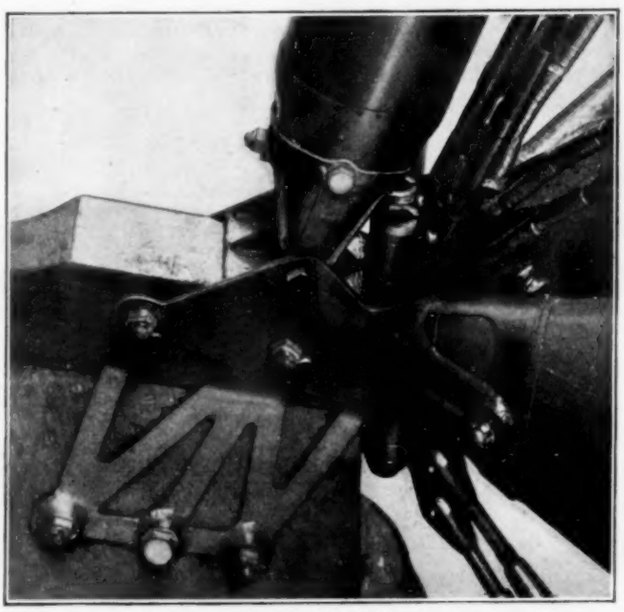


FIG. 4. DETAIL OF A WING FITTING

Through the early efforts of the Bureau coöperative work was done to develop a type of spar varnish that would give satisfactory results upon hulls, wooden parts and wing surfaces of Naval aircraft. After this varnish had been developed and specifications issued, manufacturers soon learned the method of producing it and within a short period of time it was found on the market in great quantities and at a reasonable price. The base of the varnish is tung oil. This varnish has been found highly resistant to water and has been used with most satisfactory results. At the same time there was developed a naval gray anti-actinic enamel, using as its base the same varnish previously referred to ground with certain pigments to produce the desired color and light stopping property.

Fabric Wing Covering Protection

The protection of the fabric wing covering becomes of added importance on the NC boats on account of the great area involved and the expense and difficulty of renewal. At one time, wings had to be recovered very frequently, but with the present Navy standard doping practice, the fabric stands up under favorable conditions from six months to a year.

To cover the NC surfaces about 6000 square feet of fabric has to be treated requiring over 200 gal. of dope. There are two types of dope in use at present by the Navy Department. These are known as cellulose nitrate and cellulose acetate dopes. The latter is produced from cotton treated with acetic anhydride and acetic acid, while the

other is made in a manner similar to the production of gun cotton through the use of cotton treated with nitric and sulphuric acids. The acetyl or the nitrate group is taken up by the cellulose to make a new compound which is soluble in certain solvents. The treated cotton is then dissolved in solvents such as methyl, amyl, propyl, butyl or theyl alcohol, acetone, etc., subsequently adding other non-solvent thinners such as benzol, alcohol or benzene. Different kinds of softeners and fire-resisting salts are then added to the dopes. These are usually high-boiling, slow-evaporating liquids. Diacetone alcohol is a representative of this class. Triphenyl phosphate is used for its fireproofing value. A small quantity of urea is sometimes used to prevent the acidity which may be caused over periods of storage.

Navy Practice in Doping Fabric

The present Navy practice in doping fabric is to apply first two coats of acetate dope because of its higher fire-resisting value and because of the fact that the acetyl radical present is ordinarily not injurious to fabric. There is then applied three coats of cellulose nitrate dope. A very taut surface is obtained. Naval gray enamel is then applied in one or two coats according to the wing surface to be treated. With this practice no difficulty has been experienced with scaling or cracking of the wing enamel. On the other hand, when five straight coats of acetate dope are used very serious scaling and cracking of the subsequently applied enamel will take place. The cellulose nitrate dope, moreover, is very much cheaper than the acetate dope, is readily available, has greater covering properties and gives greater tautness to the fabric.

The use of the wing enamel referred to has been a curious development which dates back to the examination of rudders on some planes that were in use in Florida several years ago. The fabric was found to be rotted in several places but in perfect condition where covered with the naval aircraft insignia paint. This indicated the value of the paint in shutting out the actinic rays of the sun. From that time on the Navy has used an anti-actinic wing enamel.

Extensive tests have been made by the Bureau on the use of so-called fireproof dopes which consist usually of cellulose nitrate in which there have been distributed fireproofing ingredients such as di-ammonium phosphate, calcium, magnesium and zinc chlorides and also tricresyl phosphate in various combinations. Good results were obtained with di-ammonium phosphate.

New types of dope have appeared in recent years under the name of pigmented dopes, first used by the British. These consist usually of highly plasticized nitrate dope in which pigments and softening materials are distributed and are used in place of varnish. The wearing value and fire-resisting properties, however, are not as high as the naval gray enamel now in use by us.

Considerable work has been done by representatives of the Bureau in factory control of conditions at contractors' plants. This work covered the heating arrangements, removal of evaporated solvents, control of humidity conditions, design of fabric covering rooms, methods of dope application and factory control in operation, studies of ventilation and hygiene. The latter is a matter of some importance as cases of so-called dope poisoning have in some instances been observed, generally in the form of eruptions on the arms of the workmen or the development of greatly swollen hands. By the elimination of all highly poisonous dope solvents such as tetra-chlora-ethane and the installation of suitable ventilation systems much of this trouble has been obviated. Through the development of emollients the hands and skin of the workmen have been protected from troublesome effects.

Glue for Laminated Construction

The very extensive use of laminated construction for wooden parts of the NC and other Naval seaplanes is dependent upon the establishment of a correct glue practice. In the NC a good deal of hide glue had to be used because, while it was realized that such glue is not waterproof unless protected by varnish, developments in the use of casein and other waterproof glues had not proceeded far enough to render their use safe and dependable. Since the NCs were started, considerable progress has been made, and the present practice is to use waterproof casein glue throughout.

The British and German aircraft builders have used a type of casein glue composed usually of casein, slaked lime, caustic soda, sodium fluoride and paraffin oil, the three latter ingredients being used in small percentage. Contemporaneously, American aircraft plants have been experimenting with types of casein glue for plywood construction produced in this country. The Bureau gave encouragement to experiments along this line and took up with the Forests Products Laboratory and the manufacturers the subject of the utilization of casein glue for strength parts of airplane construction. Through some intensive work, these glues were soon developed to such an extent that three were placed on the market by individual manufacturers in a form ready for use. These products were all thoroughly tested by the Forest Products Laboratory and found to give results which indicated their superiority over hide glue. The art of employing these glues in aircraft construction was developed with great rapidity. One of the prime requisites was the use of a power mixer for the thorough incorporation of the glue with the aqueous medium. The uniformly high strength of joints made with this glue soon indicated the value of using it almost exclusively in place of hide glue and instructions along this line were sent to all naval contractors together with information in regard to using this new type of cold glue. At the same time, through arrangements made with the Forest Products Laboratory, men were trained and sent to the various plants to install the process and put it on a working basis.

Difficulty with Laminated Construction

At first some difficulty was had with laminated construction where many laminations required a large quantity of glue and necessarily a large quantity of water. This water would pass into the wood and retard the hardening of the glue. Later on, it was found that when these pieces were dried in a warm room or in a dry kiln in the same manner as wood having too high a moisture content, the excess water would evaporate and an excellent joint resulted.

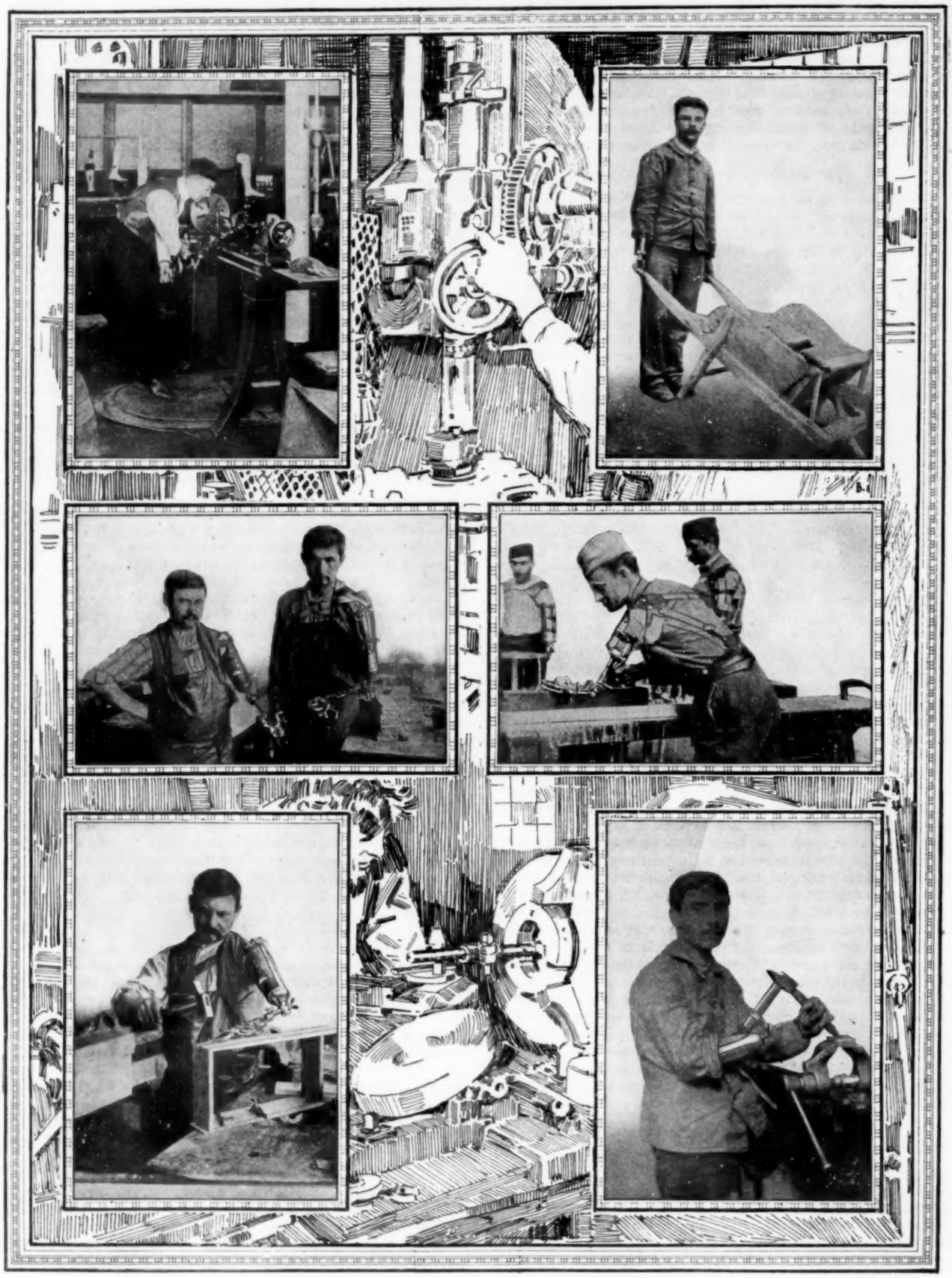
Specifications were issued for plywood constructed with blood albumen glue, this type of plywood being extensively used for hull sides and tops. It was found that panels made with blood albumen glue gave much greater strength if tested immediately after long-time soaking than panels made with casein glue. For this reason the blood albumen glue is preferred for the construction of pontoons and hulls which are exposed directly to the action of salt water. The tops of some of the NC hulls are covered with blood albumen veneer and others with the usual two-ply spruce planking riveted over fabric set in marine glue. The latter practice is somewhat heavier and more expensive but has greater life in service due to local stiffness, elasticity and ample fastening.

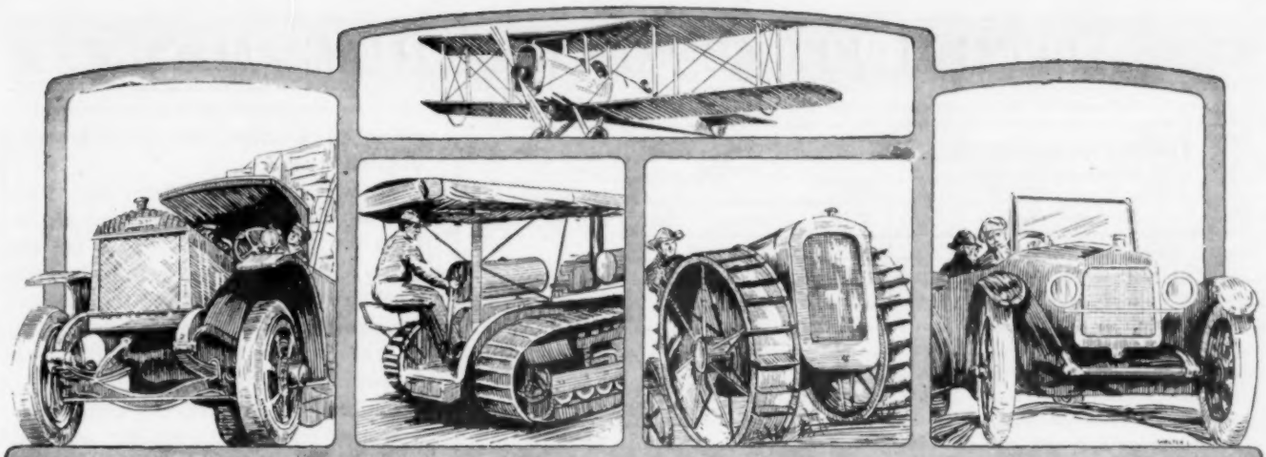
The Power-Plant Arrangement

The power-plant arrangement was originally designed to employ three Liberty engines mounted between the wings in a symmetrical manner and driving three tractor propellers (see headpiece). The radiators were mounted in front of the engines in the slip-stream of the propellers so that a good current of air would blow through the radiator when running at low speed on the surface of the water. The slip-stream was also used to drive the small windmills which pump gasoline from the main tanks in the hull to the gravity tank in the upper wing. In a similar manner, a small windmill-driven generator in the slip-stream furnishes current for the radio and for charging the storage battery for the electric self-starters.

A feature that is new in this boat is the use of welded aluminum tanks for gasoline. There are nine 200-gal. tanks made of sheet aluminum with welded seams. Each tank weighs but 70 lb., or 0.35 lb. per gallon of contents, about one-half the weight of the usual sheet steel or copper tank.

USING MECHANICAL HANDS IN THE SHOP





AUTOMOTIVE CONSTRUCTION

Planning a New Job

By OTTO KNAAK
Master Mechanic, H. H. Franklin Manufacturing Co., Syracuse, N. Y.

It is our understanding that this system has been introduced by the author, Otto Knaak. It secures coöperation in the shop and can be so modified as to apply to almost any class of work. It is certainly in line with the newer methods of management, of not only benefiting by the experience of the men in the shop, but also of tending to secure their interest from the fact that they are part and parcel of the planning as well as the production of the pieces themselves, resulting in a better output.

MACHINE CAPACITY REPORT

MODELS		DATE	MATERIAL	M.I. 26	LOT NOS.
PIECES	Steering Gear Case		SIZE	Cstg. 3446	TOTAL QUANTITY
SYMBOL		SUPERCEDES	NO. PCS. PER CAR	1	ROUTING

OPERATION NUMBER	DESCRIPTION OF OPERATION	DEPT. NO.	MACHINE	MACHINE NUMBER	MIN. PER PIECE	MIN. PER CAR	MIN. AVAILABLE PER MIN.	NO. OF CARS PER DAY
oper 1	- Sand blast							
oper 2	- Set up for oper 3 -		3436 J. & L. Machine		25.			
	Using fixture 3446 ①		← ①					
	One boring & facing block 3446 ②							
	One drill holder 3446 ③							
	One 29/64 H.S.D.S. drill							
	One 1/2-20 Morse Nut tap.							
	One #12 B. & S. Releasing tap holder with bushing							
	One sleeve for tap holder) 3446 ④							
	One facing tool block 3446 ⑤							
	One facing & chamfering tool block 3446 ⑥							
	One Kelly roughing reamer 3446 ⑦ (For reaming 2.813 hole allowing .006 for finish)		C.A. Berry F.G. Gansert					
	One Kelly finish reamer 3446 ⑧ (For reaming 2.813-2.819 hole)							

① → Similar to fixture 20941 ② used on job.

FIG. 1. (A) SHEET FROM A MACHINE CAPACITY REPORT

SUCCESS in reducing manufacturing costs depends largely on utilizing the best experience available. The plan shown in this article combines the experience and judgment of specially trained engineers with that of the men who are actually in contact with the work. If errors in judgment have been previously made, it gives an opportunity of correcting them on new jobs and it tends to promote harmony between the men and the management.

The H. H. Franklin Manufacturing Co., Syracuse, N. Y., has long been noted for the careful way in which its work has been planned in advance and handled in the shop. It has, however, somewhat modified its former system so as to secure to the full the benefit of the experience of the skilled men in its own shop in addition to that of the engineers, and further, to insure complete coöperation between the planning department and the shop itself. This at once removes one of the old causes of antagonism and gives the shop man the opportunity of suggesting, criticising, objecting or agreeing, as the case may be.

The way in which this actually works out is shown in the accompanying example, which gives the procedure in putting through a new piece which in this case happens to be a steering-gear case: The engineers in the operating or planning department look the piece over and decide on the sequence of operations which seem best. They then proceed to write out an operation sheet or sheets, as shown; the one in question consist- of nine sheets, the original being about 7 x 9 in. These preliminary sheets, examples of which are shown in Fig. 1, *A*, *B* and *C*, are called the Machine-Capacity Report. This report can contain all the various information called for or any part of it. It shows the material to be malleable iron of the quality designated as No. 26, and that the

AUTOMOTIVE CONSTRUCTION

MACHINE CAPACITY REPORT

PIECE: Steering Gear Case — MATERIAL: M.I. - 26 - — SIZE: Cstg. 3446

OPERATION NUMBER	DESCRIPTION OF OPERATION	DEPT. NO.	MACHINE	MACHINE NUMBER	MIN. PER PIECE	MIN. PER CAR	MIN. AVAILABLE PER HR.	NO. OF CARS PER DAY
Oper 2 -	Continued:							
	One 7/8 x 7/8 Std. H. S. Tool bits 3446 (1)	2-1-						
	One limit plug gauge 3446 (9) (2.813 gr - 2.814 no go)							
	One limit plug gauge 3446 (10) (for 29/64 hole)							
	One 1-20 male thd. gauge 3446 (11)							
	One limit depth gauge 3446 (8)							
	One chamfer gauge 3446 (7)							
	One 5/8 x 5/8 - Std. H. S. tool bit.							
Oper 3 -	Bore, face, drill, tap, chamfer & ream				5.6			
Oper 4 -	Set up for oper. 5 -		3136 Jones & Lamson Machine		25			
	Using fixture 3446 (A) ← (2)							
	One rough boring bar 3446 (B)							
	3/8 x 3/8 R. H. boring bar bits 3446 (B) 2							
	One finish boring bar 3446 (C)							

(2) → Similar to fixture 20941 (12) used on job

FIG. 1. (B) SHEET FROM A MACHINE CAPACITY REPORT

casting number is 3446. This number appears on the casting itself, and on all the tools and fixtures which are used in machining it.

The first operation is sandblasting, while operation No. 2 is setting up a 3 x 36 Jones & Lamson for operation No. 3. The procedure of this set-up shows all the various tools and fixtures needed in the operation, these being listed separately, and this listing shows whether they are new tools, or whether tools and fixtures already in stock can be utilized. As the piece shown in a new job, it requires nearly all new fixtures and tools. This is indicated by the method of marking shown. Each tool and fixture carries the number of castings 3446 in addition to the serial number of the tool or fixture itself. When a new tool is required a line is drawn under the casting number and a small circle with a cross in the center is made over the number to make it doubly sure. At the right of the piece number is another circle, in which is put the serial number of the tool or fixture. As will be seen on sheet *A*, these are all new tools and fixtures, eight in number. The arrow at the right calls attention to the first notation which, on referring to the note at the bottom of the sheet, tells us that the new fixture 3446 (1) is similar in design to fixture 20,941 (12). In the same way, on sheet *B*, arrow No. 2 informs us that fixture 3446 (14) is similar in design to fixture 20,941 (13). On sheet *C*, arrow No. 3 calls attention to the fact that two complete set-ups should be ordered for operation 5, as it requires more than the capacity of one machine to produce the required production.

It will also be noted that these operation sheets give the estimated time per piece in addition to the machine on which the work is to be done. Perhaps the most interesting feature, however, is the signatures which appear on these sheets, for it is the intention to have the planner consult with the foreman of the department and also one of the master workmen (or assistant foreman) operating this particular type of machinery. The proposed layout is not sanctioned and put into operation until they have been approved in writing, as shown on sheet *A*.

Accompanying the operation sheet shown are rough free-hand sketches showing the proposed tools and fixtures, as well as the tool set-ups. A set of these are shown in Fig. 2, and though these are practically free-hand and are hurriedly made, they tell the story suffciently well for the practical mechanic. And here too, he can suggest changes either in the tools themselves, in the sequence of operation, or in the proposed distribution of the work among different machines. This gives him the opportunity of pointing out any difficulties he may have had previously with the kind of tools shown, or to make any suggestions as to different tools or fixtures, and it is interesting to note that such suggestions are frequently made and in many cases adopted.

The sketches are not intended to be finished drawings, but are made to show the foremen and the workmen what tools and fixtures it is proposed to use, so that

MACHINE CAPACITY REPORT

PIECE: Steering Gear Case — MATERIAL: M.I. - 26 - — SIZE: Cstg. 3446

OPERATION NUMBER	DESCRIPTION OF OPERATION	DEPT. NO.	MACHINE	MACHINE NUMBER	MIN. PER PIECE	MIN. PER CAR	MIN. AVAILABLE PER HR.	NO. OF CARS PER DAY
Oper 4 -	Continued							
	One floating reamer bar (with pilot end) 3446 (14) 2							
	One #2 - Magic Chuck.							
	One limit plug gauge 3446 (13) (for 1.247 - 1.250 hole)							
	One limit plug gauge 3446 (12) (for 1.851 - 1.852 hole)							
	One limit plug gauge 3446 (11) (2" - 16 thd. hole)							
	One limit thread plug gauge 3446 (10) (for 2" - 16 thd. hole)							
	One recess & chamfer gauge 3446 (8)		C A Berry					
	← (3)							
Oper 5 -	Bore, face, chamfer, recess, ream & thread hole.				12.5			

(3) → Order two complete set ups on this oper.

FIG. 1. (C) SHEET FROM A MACHINE CAPACITY REPORT

AUTOMOTIVE CONSTRUCTION

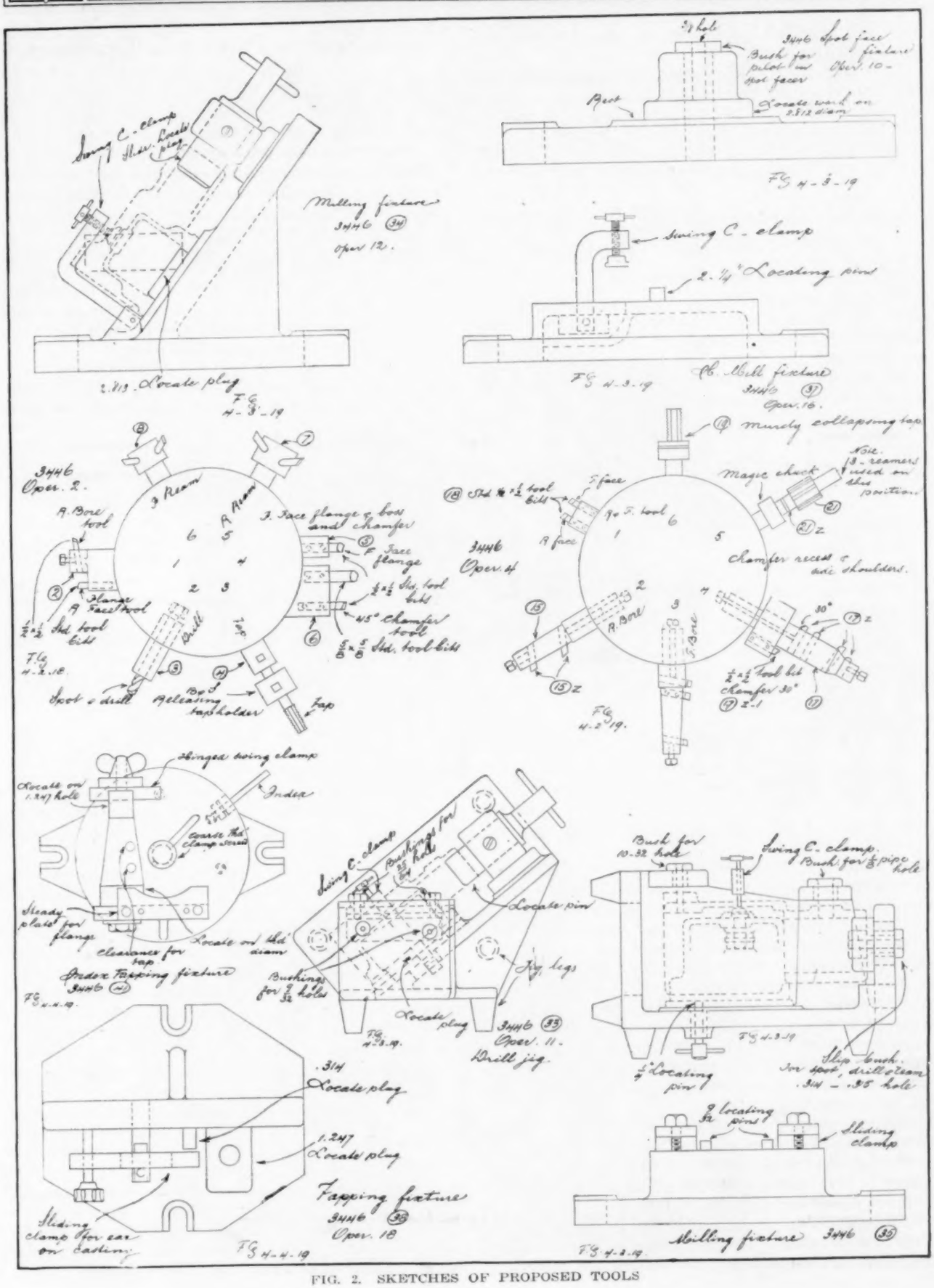


FIG. 2. SKETCHES OF PROPOSED TOOLS

AUTOMOTIVE CONSTRUCTION

they may have full information in regard to the proposed operation.

After both the operation sheet and the proposed tools and fixtures are approved, the sketches shown in Fig. 2 are turned over to the tool draftsman as a guide in making finished drawings for both the fixtures and the tools themselves. This saves much explanation and offsets the time taken to prepare the preliminary sketches.

Special Valve-Grinding Fixture for Hispano-Suiza Aircraft Engines

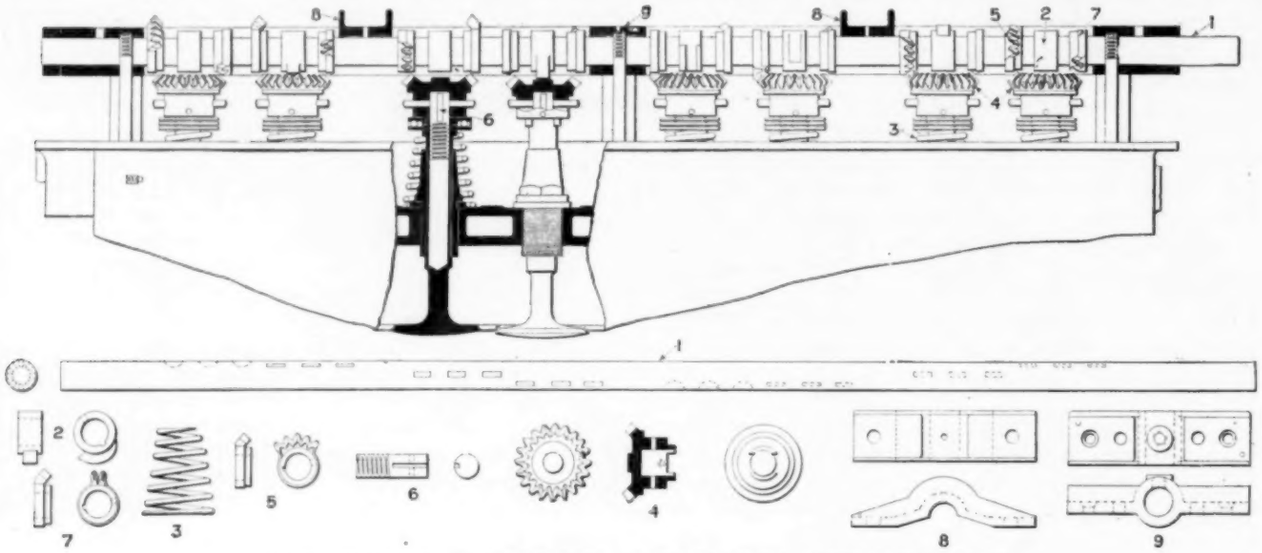
BY C. C. BALL

The figure gives the details of a valve-grinding fixture which was designed by the writer at a time when men were scarce. Driven by an electric motor, it will do the work of eight men in grinding valves.

As shown in the upper part of the illustration, the device is designed to clamp on the top of the cylinder block in place of the camshaft and grind all the valves at one time. The drive or camshaft *1* carries eight cams so arranged that there is pressure on at least one valve at all times. The cams *2* act against the bosses in the centers of the driven gears *4* and work against the coil springs *3*, which reseat the valves. There is a five-tooth forward driving gear *5* for each valve which moves the driven gear three teeth ahead, and a two-tooth reverse driving gear *7* which drives it backward two teeth for each revolution of the camshaft. The combination of this reversing rotation with the intervening depression gives the proper action for poppet-valve grinding.

The driven gear engages with the stud *6* which is screwed into the hollow valve stem in place of the valve adjusting screw and is held by the No. 2 taper pin shown. This arrangement provides a quick release without disturbing the setting.

The cylinder block is mounted on a hinged fixture (not shown) which is fastened to the bench and can be tilted backward 45 deg. for placing the valves.



VALVE-GRINDING FIXTURE FOR HISPANO-SUIZA AIRCRAFT ENGINE

Cross-Section Paper and Drawings

BY E. R. PLAISTED

Among the ardent advocates of cross-section paper was F. A. Halsey, at one time an editor of the *American Machinist*, and ever since I was induced by him to give it a trial I have been finding more and more use for it.

But despite its many advantages there are times when a plain sheet is preferable, and to secure these advantages for almost any kind of semi-transparent paper, I hit upon the scheme of ruling with sharp black lines all the faint blue lines on a sheet of cross-section paper, gluing it to a small drawing board and then covering the whole with one or more coats of a good transparent varnish. With such a board, quite an elaborate sketch can be made much more easily and in much less time than by the use of the square and triangle.

About the same time that we decided to cut down our standard shop drawings from 18 x 24-in. to something approximating an ordinary letter head (which is generally 8½ x 11 in.), a circular was sent out by the Griffith-Stillings Press setting forth the advantages of what they had named the "hypotenuse-oblong" system of sizing and subdividing sheets of paper for catalogs.

If the length of a given sheet of paper is made equal to the hypotenuse of a right-angled triangle which has the width of the sheet for both its base and its altitude then this sheet can be cut into halves, quarters, eighths, etc., and the smallest subdivision remains of the same proportional length and width as the large one.

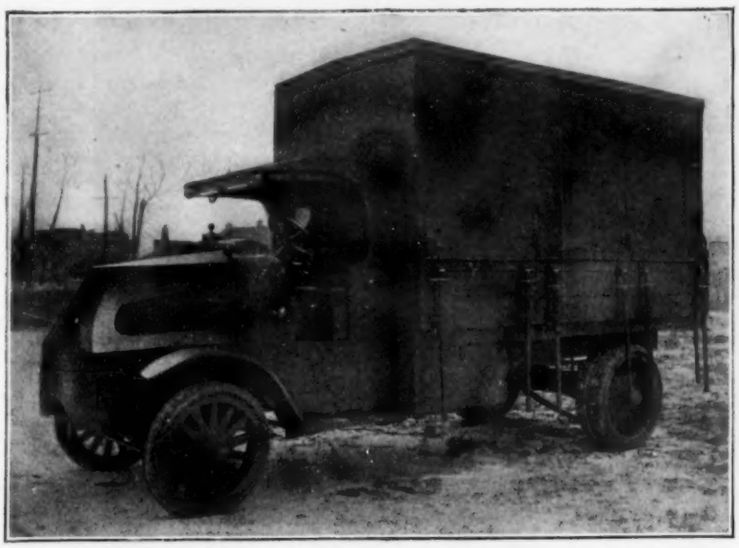
A little experimenting showed that if we started with a 24 x 34-in. sheet, it would cut in two to make 17 x 24 in. (a close approximation to our old standard size of 18 x 24 in.), and that all the smaller subdivisions would be proportioned according to this "hypotenuse-oblong" method.

The size—12 x 17 in.—proved a handy intermediate and 8½ x 12 in. is now our standard size for shop blueprints, though for the files in the shop office and for ready reference in the drafting room we continue to blueprint four of these on one 17 x 24-in. sheet.

Portable Repair Shops for the Army

By HAROLD S. LORD*
Captain of Engineers, U. S. Army

The late war has been the means of bringing out many new devices that have increased the efficiency of our fighting forces. What the repair ships are to the naval vessels at sea, the portable shops described in this article are to the Army in the field. While, from their prescribed size, they cannot carry such a varied equipment nor turn out the variety of work as can the repair ship, the amount of machines, tools and supplies carried by these portable shops is amazing, as will be apparent from a study of the illustrations and the complete equipment lists herein.



THE idea of a portable repair shop for Engineer troops did not, as most people think, originate entirely with the Corps of Engineers. Some time previous to the entrance of the United States into the European War, the Russian government had contracted with J. G. Brill Co., of Philadelphia, to build and equip several portable repair shops. These shops did not include much power-operated machinery but merely a varied supply of carpenters', blacksmiths' and machinists' tools intended as sufficient for the accomplishment of minor and temporary repairs in the field. A list of this material and the general specifications of the containing truck bodies were obtained by the General Engineer Depot which was then the purchasing organization of the Corps of Engineers. The officers of the General Engineer Depot at that time, June, 1917, after studying this data, decided that the idea was a good one and could be developed to fit the needs of the Corps of Engineers. It was decided to expand the single shop of the Russians with its equipment of hand tools, to a complete train of four trucks, equipped with power units and power-operated tools. This train, consisting of a machine-shop truck, a blacksmith-shop truck, a carpenter-shop truck, and a material or supply truck, was to be fitted with demountable bodies and equipped for making extensive and permanent repairs on Engineer equipment in the field. With this decision, to make a complete survey of the situation and work up a practical unit, the problem was turned over to Major (then Captain) O. B. Zimmerman, as the ranking mechanical engineer at that time stationed at the Depot. Major Zimmerman intrusted the body design to the drafting department, accompanied by the ideas already advanced by himself and the other interested officers. A tentative preliminary list of equipment was drawn up, based on the Russian shop, the standard engineer equipment for sapper regiments, and the ideas advanced by the officers stationed at the Depot. The whole plan in general together with the preliminary list of equipment, was approved by the Chief of Engineers, and authority was granted to work up the details with the idea in mind of purchasing a large number of equipments. At this stage, the problem was given to the writer with full authority to develop the proposition and carry it to a finish, following, of course, in general, the ideas approved by the Chief of Engineers. The first task in the analysis of the problem was to endeavor to conceive every possible use to which these units might be put, in the field. The equipment outlined had to be thoroughly reviewed and altered to fit these conditions.

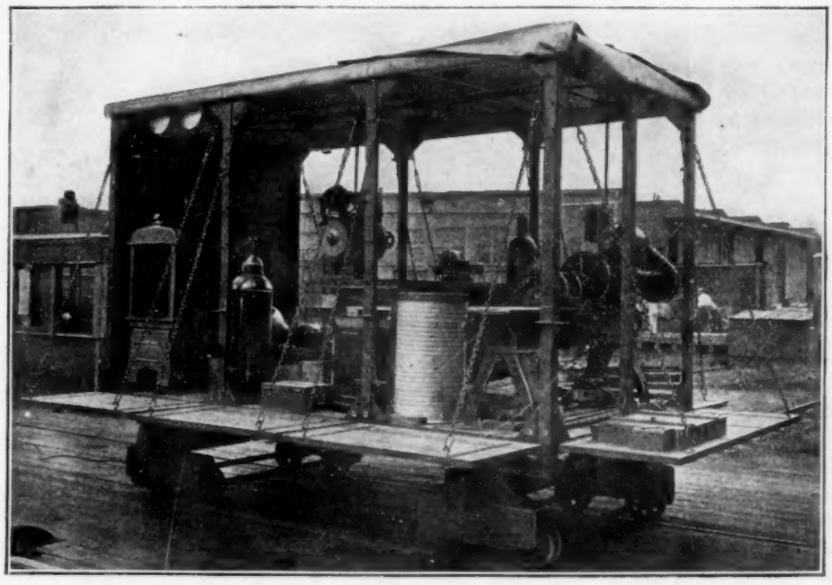


FIG. 1. THE MACHINE SHOP DISMOUNTED

Other possible conditions arose, and the equipment was again altered to fit them. Finally, after many such alterations, changes, conferences and a review of the few precedents obtainable, a new equipment list was developed. Due to the lack of competent clerical assistance and the immense flood of business which struck Washington in the last months of 1917, the work went slowly at first. Each item of the new equipment list had to be studied and a suitable specification drawn up for it. The body drawings also went slowly but were finally completed. Much credit is due to the drafting-room force for the satisfactory way in which they accomplished their task. The force had at that time no experienced structural designers and the data from which they were obliged to work was decidedly limited. Taking all these points into consideration, together with the fact that changes in the size and location of the load were constantly being made, it was decided to omit detailed drawings and merely get out assemblies showing the generalities of the construction desired. The designs produced proved eminently satisfactory and successfully accomplished the purpose for which they were intended.

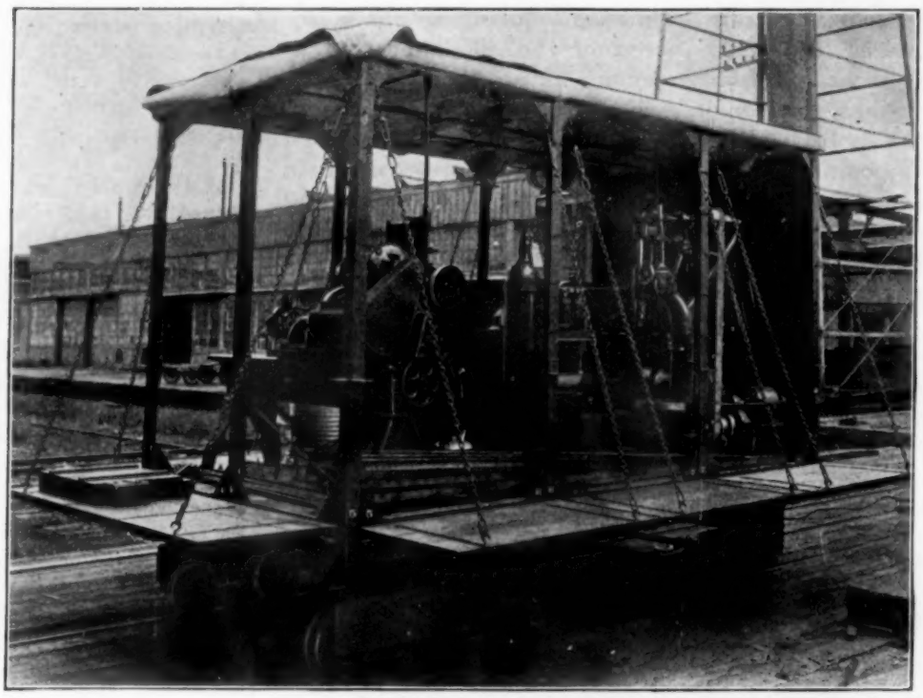


FIG. 2. ANOTHER VIEW OF MACHINE SHOP

One of the fundamental ideas of the shop-train proposition was to so design the truck bodies (see headpiece) that they might be easily demounted from the truck chassis while fully loaded with the equipment. It was originally intended that these shop units should be a part of the equipment of Engineer regiments, especially the technical regiments, and accompany the troops to points at or near the front when required. In cases where the regiment had a permanent or semi-permanent headquarters, it was intended to dismount the body from the truck chassis, thus leaving the truck chassis itself available for other uses. This idea was to some extent defeated by the order detaching all portable shops from the regimental equipment and causing them to operate from a general supply base. On account of the requirement that the bodies be demountable with their full equipment, the construction was necessarily exceptionally rigid. The machine-shop equipment alone weighed very nearly five tons, from which may easily be seen the need of a heavy body. The bodies for the machine shop, blacksmith shop and carpenter shop are 13 ft. long by 6 ft. 9 in. wide and have an approximate head room of 7 ft. There is one door at the rear and three on each side, 2 ft. 3 in. wide, hinged at the bottom and opening outward, thereby extending the floor space to approximately 15 ft. 3 in. by 11 ft. 3 in.

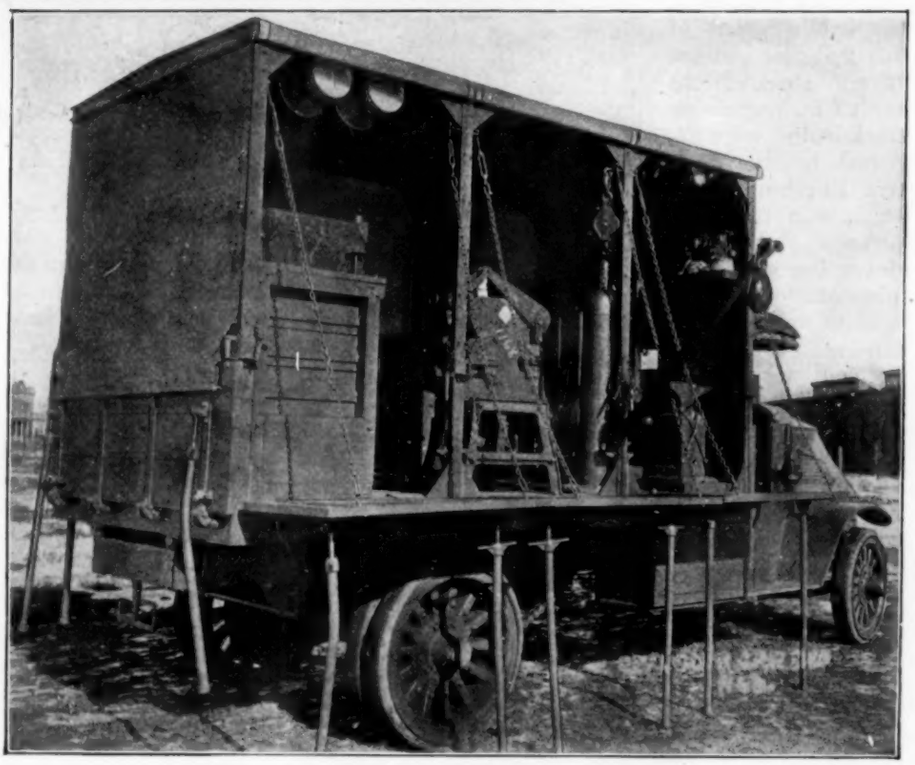


FIG. 3. THE BLACKSMITH SHOP

The floor framing is of structural steel, one 6-in. channel running the length of each side, and joined by equally spaced 4-in. channels framed into them. The corners are braced by means of large gusset plates. The flooring is made of 1½-in. maple plank.

The doors above mentioned assist in forming the sides and the rear end. They are made of 1½-in. maple plank, hinged at the bottom, steel braced at the back, and bound with steel. When closed they are held in place by a pin at each end; when open they are supported by adjustable rests fastened to them and folding against the body when they are closed. The doors are further supported by means of chains fastened to the uprights.

Construction of the Roof and Sides

The roof is supported by four upright T-irons on each side and one at the rear. Curtains of olive-drab waterproof canvas are hung from the roof and extend down far enough to overlap the doors. When the body is closed, these curtains are fastened to the uprights by means of snaps similar to those used for the curtains of automobiles, and furnish very satisfactory protection against stormy weather. When the body is opened, the curtains are used as an awning over the floor extension, being held out and up by means of rods forked at the ends and fitting in sockets in the uprights. The front is made of $\frac{1}{16}$-in. sheet steel, containing a window back of the drivers' seat.

The roof has an edge of 3-in. angles with oak ridge pole, combings and rafters. It slants both ways from the ridge pole and is covered by a layer of $\frac{5}{8}$-in. boards and a layer of 15-oz. painted waterproof canvas.

The body of the material or supply truck is the same as given above, with the exception of the sides and the rear end. In the place of the side curtains, the material truck is supplied with two doors for each of the three sections of each side. The upper one is hinged from the roof and the middle one from the upper. These doors are of the same construction as the lower ones, previously described. The rear end is made of $\frac{1}{16}$-in. sheet steel with a door in the middle, extending the full height and hung from the side. The interior is fitted with shelves and bins for carrying material and equipage. These shelves and bins are ranged along each side with an aisle down the center toward which they slant. Their contents may be reached either from the outside or from the aisle.

The Machine Shop

The machine shop, shown demounted in Figs. 1 and 2, contains the following items:

One 5-kw. Winton gasoline generator set, consisting of a four-cylinder Winton engine directly connected to a 110-volt, direct-current generator, with special radiator.
One switchboard complete with voltmeter, ammeter, Cutler-Hammer rheostat and illuminating lamp.
One 14 in. x 6 ft. Monarch geared-head engine lathe with a 1½-hp., 110-volt, motor, mounted on the headstock. The legs of this lathe were made 6 in. shorter than standard to bring down the center of gravity.
One 20 in. Silver No. 862 upright drilling machine with a 1-hp., 110-volt, direct-connected motor.
One Davis-Bournonville portable oxy-acetylene welding and cutting outfit, suitcase type, complete with two steel carrying cases, one for equipment and one for supplies, one oxygen cylinder of 200-cu.ft. capacity and one acetylene cylinder of 225-cu.ft. capacity.
One U. S. Electrical Tool Co. two-wheel bench grinding machine driven by a type K.K., 110-volt motor.
Two Electro-Magnetic Tool Co. electric hammers, type D-4, 110-volt.
One heavy-duty, side-spindle electric drill, size No. 2, "Duntley," capacity, ½-in. drills.
One work bench, 5 ft. 6 in. x 2 ft. 3 in. with an oak top 1½ in. thick, fitted with 12 drawers arranged for holding the equipment of small tools enumerated in the attached list.

Two ½-in. arbors; 1 pinch bar; 1 each outside spring calipers, 4 in. and 10 in.; 1 inside spring caliper, 6 in.; 1 firm-joint hermaphrodite caliper, 6 in.; 1 each outside micrometer calipers, 1 in. and 2 in. with ratchet stop; 1 inside micrometer caliper, 2 in. to 8 in.; 1 center gage; 1 center punch; 10 cold chisels, assorted shapes; 6 clamps, 2 each 2, 3, and 6 in.; 1 bolt clipper; 1 Star drill chuck; Morse taper shank; 1 pipe cutter; 1 pr. 8-in. dividers, solid nut; 1 pr. 4-in. dividers, spring nut; 1 set pipe dies; 1 breast drill; straight shank, high-speed twist drills as follows: 30 each $\frac{1}{16}$ in. to $\frac{1}{2}$ in. by 32nds, 12 each $\frac{33}{64}$ in. to 1 in. by 32nds, 1 each ¼ in. to 1½ in. by 16ths, 1 each 1½ in., 1⅝ in., 1¾ in. and 2 in.; 1 drill and countersink combined, $\frac{7}{16}$ in. in diameter of body, $\frac{1}{16}$ x $\frac{3}{32}$-in. drills; 1 drilling post; 1 ratchet drill; 1 emery-wheel dresser; 1 set $\frac{1}{16}$-in. steel stamps (numerals); 1 gasoline fire pot; 47 assorted files; 1 hacksaw frame; 1 gross hacksaw blades, 12 in., 20 teeth; 1 gross hacksaw blades, 12 in., 24 teeth; 1 each ball peen hammer, 1 and 1½ lb.; one 1½-lb. cross peen hammer; one 5-lb. lead hammer; one 10-lb. sledge hammer; 6 file handles; 1 lever jack; 1 screw jack; 1 plumber's ladle; 14 assorted lathe tools, size ½ x 1 in.; 7 assorted lathe dogs, ¼ in. to 8 in.; 1 set steel stamps (letters); 1 each 6-in. and 12-in. levels; one ½-in. to $\frac{7}{8}$-in. expansion mandrel; one ¾-in. to ⅞-in. expansion mandrel; one ⅞-in. to 1-in. expansion mandrel; one 1-in. to 1¼-in. expansion mandrel; 1 pr. 10-in. end-cutting nippers; two ½-pt. brass oilers; 1 pr. side-cutting pliers; 1 pr. 8-in. combination pliers; 1 revolving punch; 9 hand reamers, ¼ in. to 1 in.; 9 pipe reamers, ¼ in. to 2 in.; three 6-in. flexible-steel rules, $\frac{1}{64}$ in. graduations; two 2-ft. rules, four fold; one 300-lb. platform scale; 1 each 6-in. and 12-in. screwdrivers; 2 sets scribers; 2 sleeves for taper-shank drills; 10 lb. solder, 50/50; ½-lb. soldering paste, 4 oz. tins; 1 each 2-lb. and 3-lb. soldering coppers; 1 combination square; one 9-in. machinist's steel square; 1 oil stone; one 12-in. surface gage; 1 metallic tape; 1 set taps and dies, ¼ in. to 1 in.; 9 pipe taps, ¼ in. to 2 in.; 2 each straight, right-hand and left-hand Armstrong toolholders; 2 doz. high-speed tools, $\frac{5}{16}$-in. square, to fit Armstrong toolholders; 1 gasoline torch; 1 machinist's bench vise, swivel bottom; 1 hand vise, 4½ in. long; 1 chain wrench; one 12-in. monkey wrench; 1 each 6-in. and 10-in. S-wrench; 1 each S-wrench for nuts, ½ in. and ⅝ in., ¾ in. and ⅞ in., ⅞ in. and 1½ in., 1½ and 1⅝ in.; one 8-in. pipe wrench; one 18-in. pipe wrench; 1 pipe tap and reamer wrench; 24 sheets Crocus cloth, medium; 36 sheets each Emery cloth, coarse, fine and medium; 1 lb. emery, No. 40, No. 60, and No. 120; 1 emery wheel, 10 x 1 x ¾ in., grade 3, for type M "Hisey" grinding machine; 1 emery wheel, 10 x 1 x ¾ in., grade 4½, for type M "Hisey" grinding machine; 15 lb. babbitt metal, 5-lb. ingots; 25 ft. ⅝-in. rawhide belt lacing; 190 carriage bolts, ¼ in. to ⅝ in., assorted lengths from 1½ in. to 6 in.; 335 machine bolts, assorted sizes from ¼ in. to ⅝ in., varying in length from 2 in. to 12 in.; 6 marking brushes, assorted; 5 assorted paint brushes; 6 extension lamp cords; 1 Pyrene fire extinguisher, quart size; 1 first-aid set; 2 lanterns; 2 doz. pcs. carpenter's chalk; 2 doz. carpenter's pencils; 2 doz. soapstone crayons; 2 qts. cylinder oil, in quart cans; 2 qts. lard oil, in quart cans; 4 qts. machine oil, "Arctic," or equal, in quart cans; 12 oz. candle wick packing, 2-oz. balls; 6 saw sets; 140 hexagonal-head capscrews, ¼ in. to ⅝ in., varying in length from 1 in. to 4 in.; 140 lagscrews, ⅝ in. to ¾ in., varying in length from 2 in. to 10 in.; 140 cup-point set-screws, ¼ in. to ⅝ in., varying in length from 1 in. to 4 in.; 16 doz. flat-head wood screws, assorted sizes and lengths; 1 bar each ⅝-in., ½-in., ⅝-in. and ¾-in. round cold-rolled steel; 1 bar each ⅝ x 1-in., ½ x 1½-in. and ⅝ x 1¾-in. flat machinery steel; 1 bar flat tool steel, ½ x 1 in.; 1 bar octagon tool steel, ⅝ in.; one 3-gal. galvanized oil can, with spout; 1 galvanized storage tank with brass faucet; two 14-qt. galvanized iron buckets.

The Blacksmith Shop

The blacksmith shop shown in Fig. 3 is equipped as follows:

One 5-kw. Winton gasoline generator set, as in the machine shop. This set was installed and carried here merely as an auxiliary, there being no power-operated tools in the blacksmith shop.
One switchboard, as in the machine shop.
Two portable blacksmith's forges, "Champion No. 711," hand-operated 12-in. fan, size of hearth, 22½ x 27½ x 10 in., folding type.
One chain hoist, 2 ton, 9-ft. lift.
One chain hoist, 5 ton 12-ft. lift.
One No. 25 Toledo, geared adjustable, threading device, capacity 2½-in. to 6-in. pipe.
One No. 10-A Toledo, adjustable ratchet threading device, capacity 1-in. to 2-in. pipe.
One No. 4-B Buffalo, combination "armor plate" punch and shear.
One Davis-Bournonville portable oxy-acetylene welding and cutting outfit as in the machine shop.
One work bench as in the machine shop.

The equipment of small tools and supplies is very complete and adapted to allow the performance of all ordinary jobs of pipe fitting, blacksmithing and sheet-metal work. The list follows:

One workbench; 2 portable blacksmith forges; one 2-ton chain hoist, 9-ft. lift; one 5-ton chain hoist, 12-ft. lift; 1 portable pipe threading machine, to take 2½- to 6-in. pipe; 1 portable pipe threading machine, with extra set of dies to take 1- to 2-in. pipe; 1 shear and punch combined; 1 combination machinist's and pipe vise; 2 wind shields for use around forges; 1 power plant; one 100-lb. anvile; 2 leather aprons; 1 carpenter's ratchet brace; 6 cold chisels; 1 set pipe dies, ¼ in. to ⅝ in., with stock; 1 set pipe dies, Armstrong, sizes to 2 in., with stock; 2 wing dividers; 1 breast drill; 1 ratchet drill; 2 star pipe drills for brick and stone ¼ in. and 1 in., one each; 1 drilling post; 16 Morse taper-shank drills, one each, sizes by 16ths ¼ in. to 1½ in.; 16 straight-shank drills, sizes by 16ths, ¼ in. to 1½ in., one each; 2 drill sleeves; 2 flatters; 21 assorted files; 1 folder for sheet iron; 2 plumber's furnaces; 2 tinner's groovers; twenty-four 12-in. hacksaw blades; 2 hacksaw frames; two 3-lb. ball peen hammers; 2 claw hammers; 2 cross peen hammers; 2 riveting hammers; 2 sledge hammers, 8 lb. and

10 lb.; two 2-lb. straight peen hammers; 3 sets file handles; 2 blacksmith's hardies, 1 in. shank; two 6-in. plumber's ladles; 2 hickory mallets; 1 mandrel; 1 oil stone; 2 pipe cutters; 2 pr. 6-in. pliers; 2 pr. side cutting pliers; 4 hand punches, 1 each, Nos. 5, 7, 8 and 10; 3 tinner's punches, one each ⅛ in., 1 in. and 1¼ in.; 1 pipe reamer; 3 rivet sets; 3 soldering coppers with handles, one each 2 lb., 3 lb. and 5 lb.; 4 screwdrivers, 2 each 3 in. and 5 in.; 2 tinner's shears; 1 carpenter's square; 2 blacksmith's swages; 1 steel tape, 100 ft.; 6 blacksmith's tongs; 2 plumber's torches; 2 chain wrenches; two 12-in. monkey wrenches; 1 each Stillson pipe wrenches, 8 in., 18 in. and 36 in.; 1 adjustable tap wrench, ¼ in. to ⅞ in.; 1 adjustable tap wrench, ⅞ in. to 1½ in.; 10 lb. muriatic acid, in 1-lb. bottles; 5 lb. borax; 145 machine bolts, ⅜ in. to ⅞ in., varying in length from 1½ in. to 12 in.; 2 galvanized iron buckets; one 3-gal. galvanized-iron oilcan, short spout; 100 lb. blacksmith's coal; 20 lb. boiler compound; 100 lb. welding compound; 2 grease cups; 1 fire extinguisher; 1 first-aid pack; 26 assorted reducing bushings; 94 assorted tees, ¼ in. to 6 in.; 32 assorted caps, ⅛ in. to 4 in.; 1 each cast-iron check valves, 3 in., 4 in. and 6 in.; 2 each brass check valves, 1 in., 1½ in., 2 in. and 2½ in.; 38 assorted pipe couplings, ¼ in. to 6 in.; 1 each iron body gate valves, 3 in., 4 in. and 6 in.; 4 each brass globe valves, ⅜ in., 1 in., 1½ in., 2 in. and 2½ in.; 24 assorted crosses, 1½ in. to 3 in.; 46 assorted plugs, ⅛ in. to 6 in.; 108 assorted ells, ⅛ in. to 6 in.; 40 assorted reducing sockets, ⅜ x ⅛ in. to 6 x 4 in.; 3 pr. each pipe flanges, complete with bolts and nuts, 6 x 11 in., 4 x 9 in. and 3 x 7½ in.; 72 assorted nipples, 1 in. to 6 in.; 10 lb. grease; 2 qt. oil, 1 qt. cans; 2 qt. cylinder oil, 1 qt. cans; 2 steel oilers; 1 lb. candle wick packing; 2 lb. each gum core packing, ¼ in. and ⅜ in.; 15 sq.ft. sheet red rubber packing, 1/32 in. thick; 1½ lb. soldering paste; 45 lb. assorted oval head rivets; ¼ in. to ⅜ in., varying in length from 1½ in. to 3 in.; 3 lb. tinner's rivets, 14 oz. black; 1 pr. 10 ft. skids; 15 lb. 50/50 solder; 1 galvanized-iron tank.

The Carpenter Shop

The carpenter shop shown demounted in Fig. 5 carries the following equipment:

One 5-kw. Winton gasoline generator set as in the machine shop.

One switchboard as in the machine shop.

One No. 2½ Avey high-speed upright drilling machine with 15-in. swing, driven by a ¾-hp., 110-volt, direct-connected motor.

One No. 8 C. H. & E. saw table, with hinged steel table top 32 x 50 in., adjustable, belt tightener, cross-cut gage, rip gage and 7½-hp., 110-volt motor located under the table.

One two-wheel bench grinding machine as in the machine shop.

Two hand-operated, geared, boring machines, with three each, 1 in., 1½ in. and 2 in. augers.

One hoisting crab, hand operated, barrel 7 x 24 in., capacity 2½ tons, two speeds.

One work bench as in the machine shop.

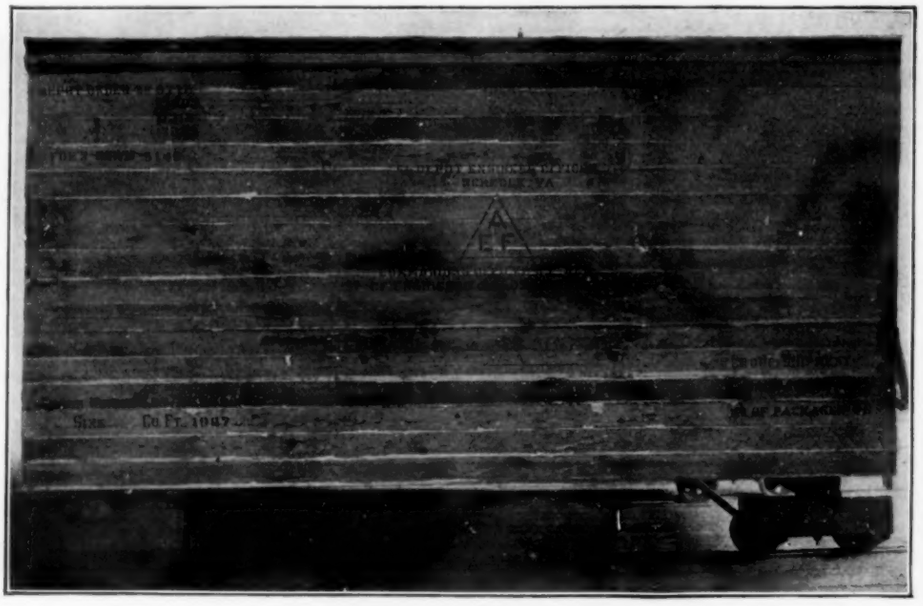


FIG. 4. A SHOP PACKED FOR OVERSEAS SHIPMENT

The following is a list of the tools and supplies carried:

One adz.; 2 sets handled ship augers, each set to comprise ⅞ in., 1⅛ in. and 1⅜ in.; 2 scratch awls; 2 axes; 1 small pinch bar; 1 large pinch bar; 1 set (seven) auger bits; 1 expansion bit; 2 screwdriver bits, 1 each ⅜ in. and ½ in.; two 8-in. double blocks; two 8-in. single blocks; 2 ratchet braces; 1 cant hook; 2 cold chisels; 2 sets framing chisels, sets to comprise one ½ in., one 1 in. and one 2 in.; four 6-in. steel clamps; 2 pr. wing dividers; 2 draw knives; 17 twist drills, ¼ in. to ⅞ in. by 32nds; 42 twist drills, straight shank, carbon steel, 2 each 1/16 to ⅜ in. incl. by 32nds and 1 each 3/16 to 1 in. by 32nds; 1 Armstrong ratchet drill; 1 drilling post; 1 doz. 6-in. taper saw files; 2 draw gages; 3 claw hammers; one 10-lb. sledge hammer; 2 hatchets; 2 jacks, single-acting lever; 2 clasp knives; two 24-in. carpenter's levels; 2 carpenter's mallets; 1 pr. 10-in. cutting nippers; 2 oil stones, one ½-pt. brass oiler; 2 jack planes; 2 pr. 6-in. pliers; 2 pr. side-cutting pliers; two 6-oz. plumb bobs; 1 revolving punch; six 2-ft. four-fold rules; 2 compass saws; 4 crosscut saws, 2 each 20 in. and 26 in.; two 26-in. rip saws; 2 saw sets; 2 screwdrivers, 1 each 3 in. and 5 in.; 2 carpenter's squares; one 100 ft. steel tape; 1 blacksmith's vise; 1 patternmaker's vise; two 12-in. monkey wrenches; 8 nail bags, 10-lb. size; 2 buckets, G. I., 14 qt.; ⅞ lb. carpenter's chalk; 6 hanks chalk lines; 1 Pyrene fire extinguisher, 1 first-aid outfit; 1 drum gasoline, 25 gal.; 1 set awl handles; 1 axe handle; 2 hammer handles; 1 hatchet handle; 2 lanterns; 100 lb. wire nails, assorted sizes; 2 qt. machine oil; 2 qt. cylinder oil; 1 doz. carpenter's pencils; ½ doz. red pencils; 4 gross assorted wood screws; 3 pkgs. tacks, 8 oz., 12 oz. and 18 oz.; four 8-in. iron wedges.

The Material or Supply Truck

A list of the regular equipment for the material truck, Fig. 6, is given herewith:

Two adzes, handles, 32 in.; 6 axes, handles, 32 in.; 2 large pinch bars; 3 cant hooks; 25 cold chisels (varying sizes and shapes); 1 set pipe dies, ⅛ in. to 2 in., complete with stock; 27 twist drills, straight shank, 1/16 in. to 1 in. incl. by 32nds; 20 twist drills, taper shank, high speed, ¼ in. to 1½ in. incl. by 16ths; 1 earth auger; 6 files, 16 in., bastard, half round; 6 files, 12 in., bastard, flat; 3 files, 12-in. bastard, round; 6 files, 16-in., mill, bastard; 6 files, 16-in., second-cut mill; 6 hammers, ball peen, three 1 lb., three 1½ lb.; 2 lead hammers, 5 lb.; 1 sledge hammer, 10 lb.; 6 hatchets; 6 mattocks; 6 picks; 1 set pipe taps, ⅛ in. to 2 in.; 1 posthole digger; 24 shovels, E. D. pattern; 1 set taps and dies ¼ in. to 1 in.; 2 monkey wrenches, 12 in.; 25 lb. Babbitt metal in 5-lb. ingots; 50 drift bolts, ½ and ⅝ in.; 370 machine bolts, from ¼ in. x 2 in. to ⅞ in. x 12 in.; 5 lb. brazing spelter; 2 buckets, galvanized iron, 14 qt.; 2 boxes Tetryl detonating caps; 1 box carpenter's chalk; 96 sheets, emery cloth, No. 00 to No. 3; 1 Pyrene fire extinguisher; 1 first-aid outfit; 100 ft. Bickford fuse; 100 ft. instantaneous fuse; 6 doz. hacksaw blades; 10 dry chemical fire extinguishers; 6 axe handles; 3 chisel handles; 6 file handles; 6 claw hammer handles; 3 machinist's hammer handles; 6 hatchet handles; 3 mattock handles; 2 pick handles; 275 ft. hose, ¾ in., smooth, 5 ply; 12 pr. hose couplings, ¾ in. cast brass; 12 bars, round iron, from ⅝ in. to ¾ in.; 36 Mazda lamps, 60 watt; 4 lanterns; 10 lb. lead; 90 lb. wire nails, from 8d. to 60d.; 2 qt. cylinder oil, in 1 qt. cans; 6 lb. candle packing wick, in 2-oz. balls; 6 lb. packing, ¼ in., ⅜ in. and ½ in. square flax, 2 lb. each; 12 sq.ft. rubber packing, ⅛ in. thick; 288 ft. pipe, ⅛ in. to 6 in. in 12-ft. lengths; 12 electric-lamp plugs; one 4-in. galvanized pump; 33 lb. button-head rivets from ⅜ in. to ¾ in., assorted lengths; 650 ft. manila rope, ¼ in. to 1 in.; 200 ft. wire rope, ⅝ in.; 1 bdl. sand sacks, with binders; 8 quires sand paper, No. 00 to No. 3; 260 hexagonal-head capscrews, ¼ to ¾ in., varying in length from 1 in. to 4 in.; 260 cup-point setscrews, ¼ in. to ⅝ in., varying in length from 1 in. to 4 in.; 1 gross each flat-head, gimlet-point, wood screws, ⅜ x 6, 1½ x 10, 1¼ x 9, 2½ x 14; 1 sheet lead, 24 x 48 in., 1/16 in. thick; 1 sheet brass, 24 in. x 48 in., 20 gage; 2 sheets iron, black, 24 x 96 in., 20 gage; 2 sheets iron, galvanized, 24 x 96 in., 20 gage; 12 lamp sockets; 1 lb. soldering paste, 4-oz. tins; 10 lb. solder, 50/50; 2 lb. wire solder, ⅛ in.; 1 bar each round cold-rolled steel, ⅜ in., ½ in., ⅝ in., ¾ in., 1 in., 1¼ in.; 1 bar each square cold-rolled steel, ¼ in., 5/16 in., ⅜ in., 7/16 in., ½ in.; 2 bars each flat machinery steel, ½ x 1½ in., ½ x 2 in., ¾ x 1 in., ⅜ x 1 in., ⅜ x 1½ in., ½ x 2 in., ⅝ x 2½ in.; 1 length each tool steel, ½ in., 5/16 in. and ⅜ in. square, ⅜ x 1 in. and ½ x 1 in. flat, ⅜ in., ⅝ in. and ¾ in. octagon; 2 lengths each steel angles, 1½ x 1½ x ⅛ in., 2 x 2 x ¼ in., 3 x 3 x 5/16 in.; 1 storage tank, 20 gal. galvanized iron; 25 lb. trinitrotoluol, rectangular, ½-lb. blocks; 25 each washers, ¼ in., ⅜ in., ½ in., ⅝ in., ¾ in. and ⅞ in.; 6 steel wedges, 8 in.; 10 lb. insulated wire, for lamp cords; 6 spools bare copper wire; 100 ft. each iron wire, Nos. 8, 12 and 16; 100 ft. each music wire, Nos. 13 and 20.

All of the items are commercially standard and require no description. The regular equipment requires only a small part of the body space; the remaining space is to enable special equipment, rations and baggage of the crew, gasoline, water, etc., to be carried on extended trips.

The equipment of all trucks is so arranged as to be easily removable from the bodies. In the shop trucks even the machinery and work benches may be removed by taking out a few bolts. Each of the power-operated tools is equipped with a 50-ft. cable with plugs and sockets so that the tool itself may be removed to some

distance and still be operated from the switchboard situated in the body of the truck.

Large hand tools and supplies such as crosscut saws, crowbars, buckets, lanterns, etc., are hung from the roof in specially designed brackets. Twist drills and auger bits are put up in canvas rolls. The fine tools, such as micrometers, calipers, squares, etc., are installed in especially designed compartments in the drawers of the work benches. Rope, chain, hoists, steel bars, pipe fittings, etc., all have their proper compartments designed to accommodate the quantity supplied. Nails, screws, bolts, rivets and other small supplies are carried in the drawers of the work benches.

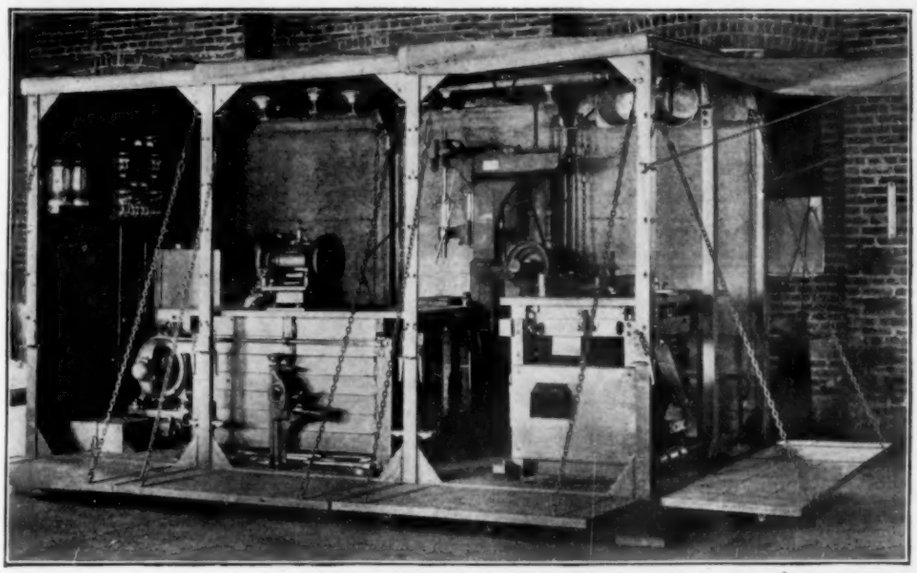


FIG. 5. THE CARPENTER SHOP

The arrangement of the machinery and storage compartments was carefully studied with the view of giving a maximum working space when the machinery was operated on the truck. This arrangement was made with the understanding that it might require alteration in the field to suit special conditions, and special care was taken to make this rearrangement as easy as possible.

The switchboards are so constructed that two or more power plants may be connected in parallel. The auxiliary power plant in the blacksmith shop is carried for the purpose of assisting in case of overloads as well as a replacement in case of breakdown. Machinery in one shop may be operated from the switchboard of another by means of the extension cables.

The bodies are so designed that they can be carried by any 5-ton truck, with a slight adjustment of their oak sills. They are fastened to the truck chassis channels by means of U-bolts especially designed. The 5½-ton Mack truck chassis manufactured by the International Motors Co., of Allentown, Penn., were purchased to carry these equipments.

Authority was granted by the Chief of Engineers for the purchase of 34 machine-shop trucks, 30 blacksmith-shop trucks, 30 carpenter-shop trucks and 30 material or supply trucks. The bodies of all trucks were built by the St. Louis Car Co. of St. Louis, Mo., at a cost for the 94 shop truck bodies of $685 each, and for the 30 material truck bodies of $995 each. The equipment for all trucks was sent to St. Louis and there installed in the various bodies at a cost, for the 64 machine-shop and carpenter-shop bodies of $270 each, for the 30 blacksmith-shop bodies of $241 each, and for the 30 material bodies of $193 each.

The total cost to the Government of the 124 equipments complete with bodies, contents and truck chassis was approximately $1,000,000.

FIG. 6. THE SUPPLY STORE

The machine shops with equipment, body truck chassis and packing cost about $8500 each, the carpenter shops about $7600 each, the blacksmith shops about $7800 each, and the material trucks about $5000 each.

It was thought advisable to keep a resident inspector at the St. Louis Car Co., to have charge of the Government's interests and to decide points on the assembly, construction, etc., which were not included in the in-

structions issued at Washington. Capt. Michael Guerin was appointed to this position and much of the success of the enterprise was due to Captain Guerin's indefatigable efforts. He received the thousands of items of equipment which were ordered shipped to St. Louis, inspected their quality with reference to specifications and materially aided in assembling them in the bodies. He supervised the construction work, carried on a very minute inspection and had charge of the shipping.

Study Made of Packing

With the exception of one unit of four shops, one of each kind, shipped to Washington Barracks for inspection, and 17 shops shipped to Camp Humphreys, the entire number of bodies were packed for export shipment and sent to France. The shipment to Washington Barracks taught us that the packing must be very secure in order to withstand the rough usage of ocean travel. To this end much study was given the subject of packing.

It was finally decided after a conference between Captain Guerin, the officials of the St. Louis Car Co., and the writer to pack the whole body and contents as a unit (see Fig. 4). The machinery was securely anchored and braced and in the shop bodies, the uprights and front end removed and packed with the roof directly on top of the machinery. The roof was held up by temporary wooden uprights. The material truck bodies were packed in their final assembled condition.

The packing cases were made of four 6 x 6-in. timbers on each side joined at the top and bottom by 6 x 6-in. timbers and having 6 x 6-in. timbers running the entire length of the sides, both top and bottom. All framing was securely bolted together and further reinforced by tie rods. The entire body except the bottom was covered with 2-in. planks, tongued and grooved.

It was the writer's intention to make these cases sufficiently strong to withstand the shock of a drop or to carry any load that might be piled upon them. The bodies with equipment, packed, weighed approximately 17,000 lb. each. The packing cost $245 each.

Twenty-one of the shops and material bodies were used at the Engineer School at Camp Humphreys. The remainder went to France and saw service there. The various reports received from them have proved their value which has in all cases been satisfactory.

Reminiscences from the Antipodes—What Ailed the Oil Engine?

By John Miles
Keilor, Australia

I happen to live near a river along which small irrigation blocks are scattered.

One morning a farmer (farmers on this island are called "cockies") called me up and told me that his oil engine, which he had had but a few weeks, wouldn't run. "It ran splendidly the last time I used it," he said, "and I would have bet anything she would run right away this morning, but she won't cough a bit, and no smoke comes out of the chimney when I pull her 'round. Just come over and have a look at her; can't be much wrong."

I went over. Spanners everywhere—kerosene tins in profusion on the grass just by. The engine had an open reservoir which was filled with kerosene by a pump, the oil then feeding to the jet by gravity.

I examined the liquid in the reservoir and it looked like water.

"What did you put in the tank this morning?" I asked.

"Kerosene," he replied.

I took another sniff. "Are you sure it was kerosene?"

"Sure! I'm sure. Did you think it was water?"

I dipped a rag in the tank and handed it to him to light. He applied a lighted match but it only sizzled and sputtered and refused to ignite.

Cocky's language was sulphurous and unprintable

"I pulled that——— engine around for two hours this morning," he said sorrowfully.

The water was emptied out, kerosene put in, and away went the engine merrily. I consoled the farmer thus: "If you had got that engine to run on water you would have made a fortune."

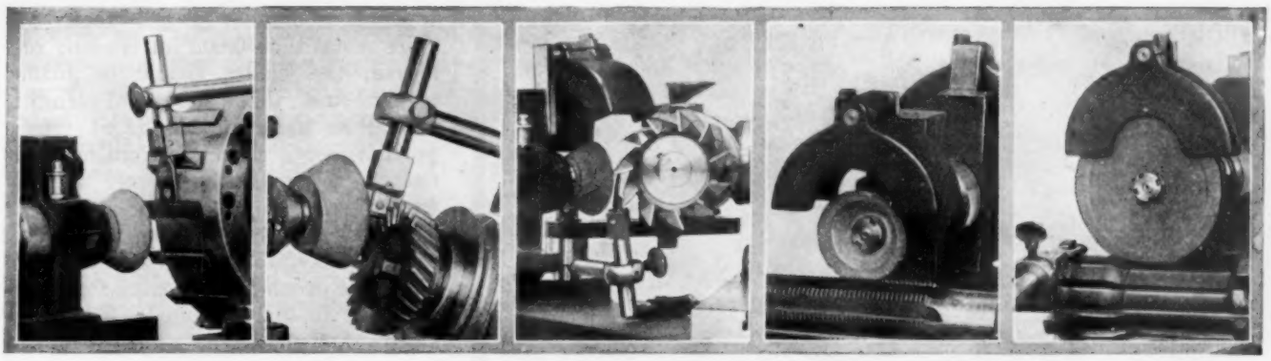
"And I would have got you to make the engines," was his reply.

Section-Lining Kink

By George W. Childs

The scheme of section lining, referred to in the article by E. L. Caldwell on page 73 of *American Machinist*, appeared familiar to me and seemed like an old acquaintance showing up after many years' absence.

I started as an apprentice draftsman with the firm of Poole & Hunt (now the Poole Engineering and Machine Co. of Woodberry, Baltimore, Md.) during 1886 and would like to state that Mr. Caldwell's scheme was at that time in use by the young and inexperienced draftsman at the works mentioned. I do not believe that I used it any longer than six months before I realized that it should be thrown away and discarded. From that time I have never used one in any form, and I have worked on many drawings which were required to be almost a work of art, such as patent-office drawings, etc. I have worked in over a score of drafting rooms in the position of draftsman and chief draftsman, and with only one exception have I ever met a draftsman using a section liner of any kind. The above exception was when I was draftsman in charge of the Ordnance Department, U. S. A., and I soon discouraged the user when I showed him men in the office who did as well using a triangle and judging the spacing with their eyes. In my opinion no section liner of any style or make should be used even by a beginner. I have been instructor in evening schools for many years, and certainly would not allow one to be used in the classroom.



Latest Practice in Cutter Grinding*—IV

The operation of sharpening reamers is far more delicate and requires a much higher degree of accuracy than that of sharpening milling cutters. This article describes modern practice in hand and chucking reamer grinding for steel, cast iron and bronze. Tables are included which give the vertical adjustment above the center for both cutting clearance and second clearance.

WHEN sharpening a milling cutter on a grinder equipped with a clearance setting dial, the operator need simply bring the work centers into the same horizontal plane with the center of the grinding wheel spindle, revolve the cutter through the proper number of degrees as read from the dial, set the tooth rest to the tooth of the cutter, readjust vertically by raising the knee, and proceed with the grinding. The accuracy of the clearance angle depends upon the accuracy with which the lines of the cutter setting dial have been matched. It is well known that it is impossible to match such lines to a high degree of accuracy, but an error of a few minutes in the clearance angle of a milling cutter does not preceptibly affect the results.

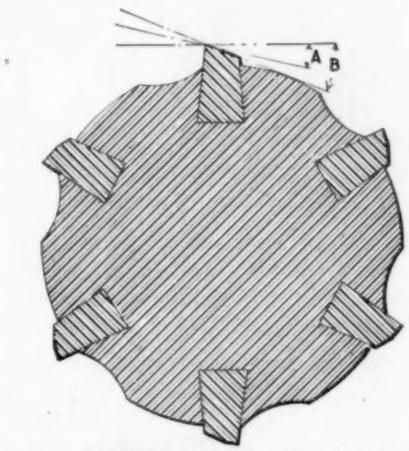


FIG. 37. SECTION OF AN INSERTED BLADE REAMER

However, the clearance angle of a reamer must be correct within a few minutes, or it will not operate satisfactorily. It is clear that the very close accuracy required can not easily be obtained by matching lines on a dial reading in degrees, and we therefore recommend a different method for reamer sharpening.

Since a narrow land of constant width is required, two settings are always necessary: *First*, the setting for sharpening the reamer by grinding the proper clearance angle, and *second*, a supplementary setting for grinding off the heel of the blade, so as to bring the land to the desired width, as explained later.

The simplest method of accomplishing this, and the most exact one, is by using the micrometer dial on the elevating shaft of the machine, and determining the setting from the accompanying clearance tables. The tooth rest should be placed on the grinding wheel head, and it need be set only once, that is, for the clearance angle. For the backing off operation, the only adjustment required is raising the knee the amount given in the table. No second adjustment of the tooth rest is required.

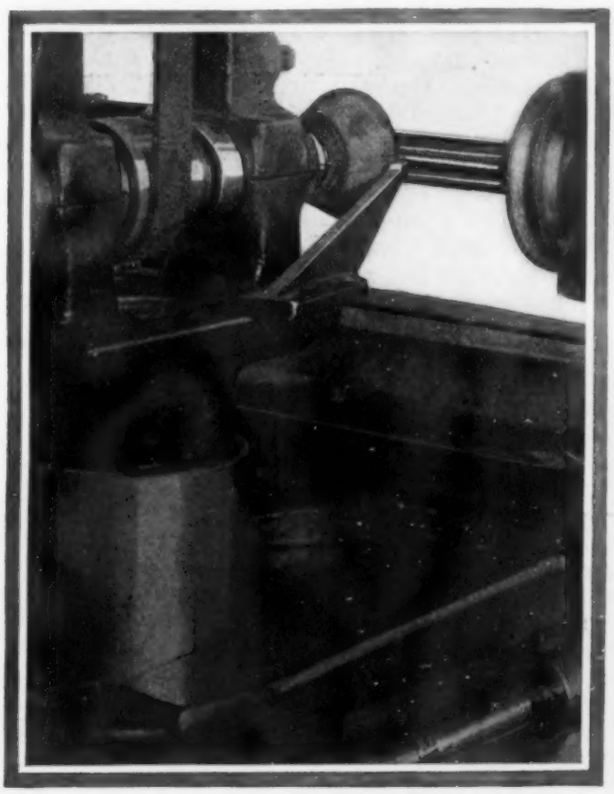


FIG. 38. USE OF CENTERING GAGE IN GRINDING REAMER

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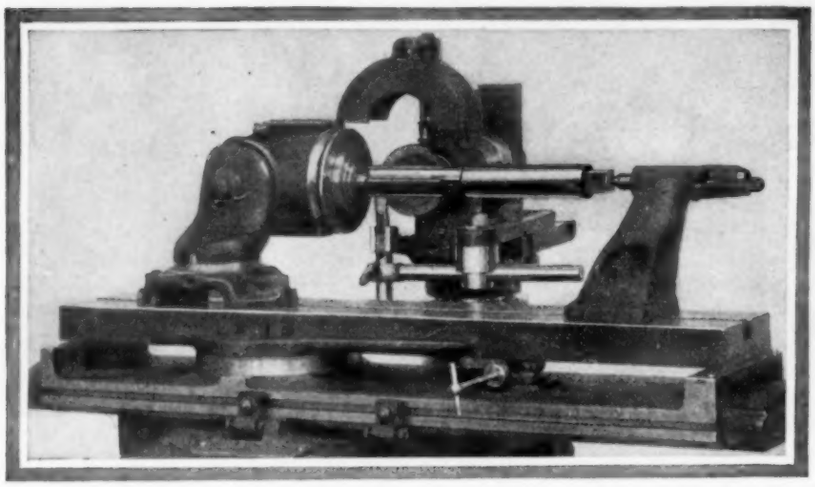


FIG. 40. TOOTH REST IN POSITION FOR SHARPENING HAND REAMER

The information that follows is taken from our own practice. This may differ from methods used by others, but it details the methods which have given us highly satisfactory results for many years.

The tables presented in this issue were developed from very extensive experiments, conducted by the

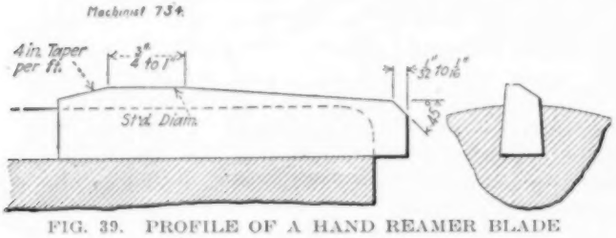


FIG. 39. PROFILE OF A HAND REAMER BLADE

Cincinnati Milling Machine Co. a number of years ago, to determine the best clearance angle and the best method of sharpening reamers of different diameters and for different materials. The figures in the first column represent the diameter of the reamer to be ground, the second column the setting for the cutting clearance or clearance angle *A*, Fig. 37, and the third column the second clearance or backing off angle, as indicated by angle *B*.

The profile of a blade of a hand ramer as we grind it, is shown in Fig. 39. The edge of the reamer may be considered as divided into three parts: the front taper part, which allows the reamer to enter the hole freely and which removes most of the metal; the straight part, which does the finish cutting and which is the exact diameter of the hole to be reamed; and, finally, the rear taper part, which saves the hole from being marred when the reamer is removed. The length and amount of taper of the front part depends mainly on the amount of metal to be removed and the diameter of the reamer. It is our practice to leave 0.0015 in. to 0.002 in. of metal to be removed by hand reamers. The length of the front taper part is from 1½ to 2½ times the diameter of the reamer, and the taper is about $\frac{1}{64}$ in. per foot. If more metal than 0.002 in. is to be removed, the blades should be made longer and this additional length should be used for the front taper portion only, thus distributing the cutting action of the reamer over a longer section.

The straight part of the reamer is about $\frac{3}{4}$ in. to 1 in. in length, and should be ground to the exact diameter of the hole to be reamed. The rear taper part should be about $\frac{1}{4}$ in. in length and the taper about $\frac{1}{4}$ in. per foot. This portion does not do any cutting at all, the taper being provided solely to eliminate the sharp corner at the extreme end of the blade so that the reamer may be removed without injuring the hole.

The beveled corner at the front of the reamer should be provided when the reamer is made. It does not perform any cutting, but simply eliminates the sharp corner at this point and requires, therefore, no special care when grinding.

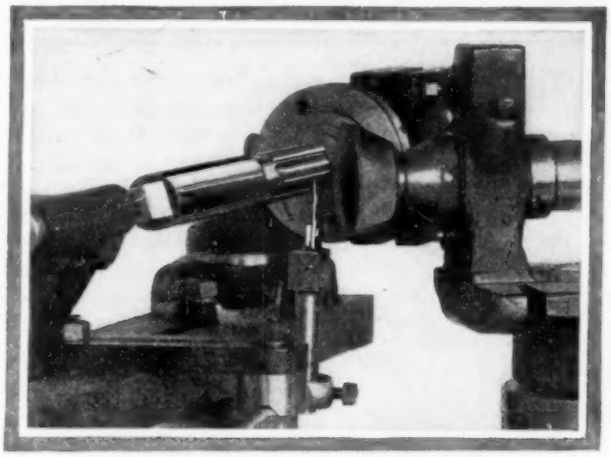


FIG. 42. PROPER SETTING FOR BEVELING CORNERS

For this we use cup wheel No. 2. The tooth rest is mounted on the grinding wheel head, as shown in Fig. 40, the reamer is held against the tooth rest by hand and the lever feed is used.

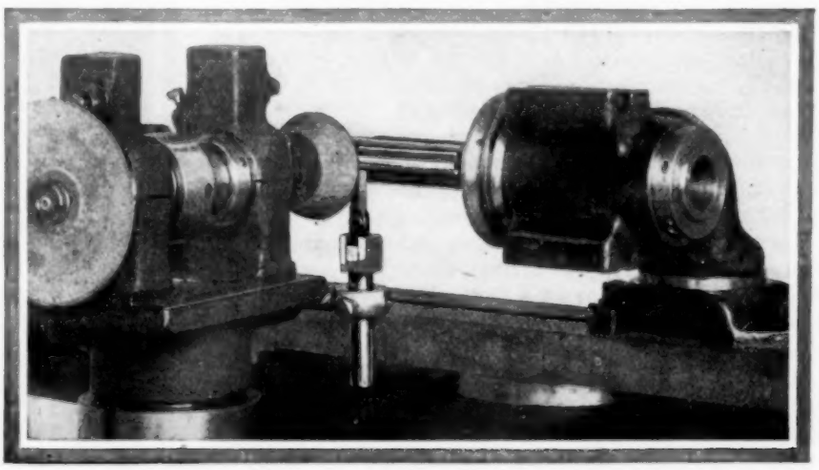


FIG. 41. GRINDING CLEARANCE ON HAND REAMER

After setting up the machine, as described in the preceding part of this article, the following operations are required for properly sharpening these reamers: In the first setting for grinding the cutting clearance, as shown in Fig. 41, the full length of the reamer is first ground straight, then the front taper portion to a taper of $\frac{1}{64}$ in. per foot by swiveling the table, after which the back taper is ground $\frac{1}{4}$ in.

REAMER CLEARANCE TABLE

Size of Reamer, In.	Table 1 Hand Reamer for Steel Land of Cutting Clearance 0.006 Wide: Vertical Adjustment for Cutting Clearance, In.	Table 1: Vertical Adjustment for Second Clearance, In.	Table 2 Hand Reamer for Cast Iron and Bronze Land of Cutting Clearance 0.025 Wide: Vertical Adjustment for Cutting Clearance, In.	Table 2: Vertical Adjustment for Second Clearance, In.	Table 3 Chucking Reamer for Cast Iron and Bronze Land of Cutting Clearance 0.025 Wide: Vertical Adjustment for Cutting Clearance, In.	Table 3: Vertical Adjustment for Second Clearance, In.
$\frac{1}{4}$	0.012	0.052	0.032	0.072	0.040	0.080
$\frac{5}{16}$	0.012	0.057	0.032	0.072	0.040	0.080
$\frac{3}{8}$	0.012	0.062	0.032	0.072	0.040	0.090
$\frac{7}{16}$	0.012	0.067	0.035	0.095	0.040	0.100
$\frac{1}{2}$	0.012	0.072	0.035	0.095	0.040	0.100
$\frac{9}{16}$	0.012	0.077	0.037	0.095	0.045	0.125
$\frac{5}{8}$	0.012	0.082	0.040	0.120	0.045	0.125
$\frac{11}{16}$	0.012	0.087	0.040	0.120	0.045	0.125
1	0.012	0.092	0.040	0.120	0.045	0.125
$1\frac{1}{16}$	0.012	0.097	0.040	0.120	0.045	0.125
$1\frac{1}{8}$	0.012	0.102	0.040	0.120	0.045	0.125
$1\frac{3}{16}$	0.012	0.106	0.042	0.122	0.045	0.125
$1\frac{1}{4}$	0.012	0.112	0.045	0.145	0.050	0.160
$1\frac{5}{16}$	0.012	0.118	0.045	0.145	0.050	0.160
$1\frac{3}{8}$	0.012	0.122	0.045	0.145	0.050	0.160
$1\frac{7}{16}$	0.012	0.127	0.045	0.145	0.055	0.175
$1\frac{1}{2}$	0.012	0.132	0.048	0.168	0.055	0.175
$1\frac{9}{16}$	0.012	0.137	0.050	0.170	0.055	0.175
$1\frac{5}{8}$	0.012	0.142	0.050	0.170	0.060	0.200
$1\frac{11}{16}$	0.012	0.147	0.050	0.170	0.060	0.200
$1\frac{3}{4}$	0.012	0.152	0.052	0.192	0.060	0.200
$1\frac{13}{16}$	0.012	0.157	0.052	0.192	0.060	0.200
$1\frac{7}{8}$	0.012	0.162	0.056	0.196	0.060	0.200
$1\frac{15}{16}$	0.012	0.167	0.056	0.196	0.064	0.200
2	0.012	0.172	0.056	0.216	0.064	0.224
$2\frac{1}{16}$	0.012	0.172	0.056	0.216	0.064	0.224
$2\frac{1}{8}$	0.012	0.172	0.059	0.219	0.064	0.224
$2\frac{3}{16}$	0.012	0.172	0.059	0.219	0.064	0.224
$2\frac{1}{4}$	0.012	0.172	0.063	0.223	0.064	0.224
$2\frac{5}{16}$	0.012	0.172	0.063	0.223	0.064	0.224
$2\frac{3}{8}$	0.012	0.172	0.063	0.223	0.068	0.228
$2\frac{7}{16}$	0.012	0.172	0.063	0.223	0.068	0.228
$2\frac{1}{2}$	0.012	0.172	0.065	0.225	0.072	0.232
$2\frac{9}{16}$	0.012	0.172	0.065	0.225	0.072	0.232
$2\frac{5}{8}$	0.012	0.172	0.065	0.225	0.075	0.235
$2\frac{11}{16}$	0.012	0.172	0.065	0.225	0.075	0.235
$2\frac{3}{4}$	0.012	0.172	0.065	0.225	0.077	0.237
$2\frac{13}{16}$	0.012	0.172	0.065	0.225	0.077	0.237
$2\frac{7}{8}$	0.012	0.172	0.070	0.230	0.080	0.240
$2\frac{15}{16}$	0.012	0.172	0.070	0.230	0.080	0.240
3	0.012	0.172	0.072	0.232	0.080	0.240
$3\frac{1}{16}$	0.012	0.172	0.072	0.232	0.080	0.240
$3\frac{1}{8}$	0.012	0.172	0.075	0.235	0.083	0.240
$3\frac{3}{16}$	0.012	0.172	0.075	0.235	0.083	0.243
$3\frac{1}{4}$	0.012	0.172	0.078	0.238	0.083	0.243
$3\frac{5}{16}$	0.012	0.172	0.078	0.238	0.087	0.243
$3\frac{3}{8}$	0.012	0.172	0.081	0.241	0.087	0.247
$3\frac{7}{16}$	0.012	0.172	0.081	0.241	0.090	0.247
$3\frac{1}{2}$	0.012	0.172	0.084	0.244	0.090	0.250
$3\frac{9}{16}$	0.012	0.172	0.084	0.244	0.090	0.250
$3\frac{5}{8}$	0.012	0.172	0.087	0.247	0.093	0.253
$3\frac{11}{16}$	0.012	0.172	0.087	0.247	0.093	0.253
$3\frac{3}{4}$	0.012	0.172	0.090	0.250	0.097	0.257
$3\frac{13}{16}$	0.012	0.172	0.090	0.250	0.097	0.257
$3\frac{7}{8}$	0.012	0.172	0.093	0.253	0.100	0.260
$3\frac{15}{16}$	0.012	0.172	0.093	0.253	0.100	0.260
4	0.012	0.172	0.096	0.256	0.104	0.264
$4\frac{1}{16}$	0.012	0.172	0.096	0.256	0.104	0.264
$4\frac{1}{8}$	0.012	0.172	0.096	0.256	0.104	0.264
$4\frac{3}{16}$	0.012	0.172	0.096	0.256	0.106	0.266
$4\frac{1}{4}$	0.012	0.172	0.096	0.256	0.106	0.266
$4\frac{5}{16}$	0.012	0.172	0.096	0.256	0.106	0.266
$4\frac{3}{8}$	0.012	0.172	0.096	0.256	0.108	0.268
$4\frac{7}{16}$	0.012	0.172	0.096	0.256	0.108	0.268
$4\frac{1}{2}$	0.012	0.172	0.100	0.260	0.108	0.268
$4\frac{9}{16}$	0.012	0.172	0.100	0.260	0.108	0.268
$4\frac{5}{8}$	0.012	0.172	0.100	0.260	0.110	0.270
$4\frac{11}{16}$	0.012	0.172	0.100	0.260	0.110	0.270
$4\frac{3}{4}$	0.012	0.172	0.104	0.264	0.114	0.274
$4\frac{13}{16}$	0.012	0.172	0.104	0.264	0.114	0.274
$4\frac{7}{8}$	0.012	0.172	0.106	0.266	0.116	0.276
$4\frac{15}{16}$	0.012	0.172	0.106	0.266	0.116	0.276
5	0.012	0.172	0.110	0.270	0.118	0.278
$5\frac{1}{4}$	0.012	0.172	0.118	0.278	.....	.....

taper per foot for a length of from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. depending upon the diameter of reamer.

The second setting takes care of grinding the second clearance or backing off. In this the back taper portion is first ground. (This operation is performed first because the reamer is already set, having been left in this position by the last operation of grinding for cutting clearance.) Next the table is swung into the straight position and the straight portion ground, and finally into position for the front tapering and backing off of this part of the blade.

It must be noted that when backing off the reamer the land should be left not over 0.020 in. to 0.025 in. wide. The reamer should be oiled-stoned only enough to remove the marks left by the grinding wheel.

For beveling the corners, if necessary, attach the tooth rest to the table, swing the table to an angle of 45 deg. as shown in Fig. 42, and set the dogs on the table slide to limit the stroke. The lever feed is used and the reamer is held by hand against the tooth rest.

The Young Man's Chance To Be a Foreman

By P. T. Spurr

In these days of rapid changes and large undertakings, the demand for competent foremen is greater than it has ever been in the past. All managers are eager to learn of promising men in their organizations who have that extra ability of some kind which always distinguishes the successful department head.

The writer knows of an important department in a large plant where there is a splendid opening for a good man to take charge, but in which there is not a single man who has shown the "class" to warrant the manager in appointing him to the position. The present foreman is not making good and the worst part of it is that he does not know it. He is all right in some ways but even his own men know that he is not "onto the job."

To replace him with some other man now working under him might overcome some of the trouble, but the new man might fail in some other way; therefore, the manager has done nothing rather than make a change without bettering the situation. He could go outside and bring in a foreman, but this would cause dissatisfaction among the men who have worked long and faithfully for the company. Some of them doubtless feel that they should be given a chance, but since none of them has given enough evidence of the sort of ability that the management is looking for the risk is too great.

What does the manager look for in his foremen? The writer believes that among the many desirable qualifications some are prominent. Beyond the ability to get out the work, perhaps the first one the manager really wants in his foremen is the ability to command the respect of his men. That does not mean the ability to make them obey, which is a far different thing. If the men do not obey they may be dismissed, but no foreman can compel his men to respect him unless he merits their regard.

The foreman who can only accomplish results by bullying is rapidly losing favor with progressive concerns and by many he is not tolerated at all. Some men may be lazy or difficult to manage but the leader usually gets better results than the driver, and what few exceptions there are do not warrant the continuance of the old-fashioned boss who considered it his chief duty to rule.

The foreman represents the management to the men. If his representation is correct and he maintains the standards the management is striving to establish, he is of great value, but if he runs counter to its larger policies because of prejudice or of lack of the quality of

leadership, he may cause more trouble than all his good points can make up for. The foreman also represents the men to the management and a very important part of his work is to prevent misunderstandings. There is so much of mutual interest between the workers and owners that the foreman, who is the connecting link between them, is in a position to do much toward the establishing of a better relationship than has sometimes existed in the past. If the foreman is big enough he will do this, but if he is small in his outlook or make-up he may fail when his opportunity comes.

It is an old saying that a man must know how to obey orders if he is to know how to give them. The man who frets under reasonable regulations is very apt to be arbitrary and unreasonable when he prescribes regulations for others. One way for a man to size up himself is to consider his attitude toward those in authority above him. Someone must control the plant. If a man is not broad enough to understand the needs of the business apart from the individual's preferences and to act accordingly, how can he expect in his turn to secure compliance in his subordinates?

The Successful Leader

The successful leader is the man who can see both sides of a question and make far more correct decisions than incorrect ones. The man who never makes incorrect decisions usually does not make any, but the man who makes too many generally finds his opportunities for making them becoming less and less until he reaches his level.

Clear thinking is a product of effort long continued, quite as much as clear speaking or clear writing. If a man always goes along with the crowd he is apt to stay with the crowd while the straight thinker goes to the head of the procession.

Abraham Lincoln once said that you "cannot fool all the people all the time;" it is just as true that no foreman can make his men think he knows his business for very long unless he really knows it. No matter how clever a foreman is, if his men are any where near his equal in intelligence, they will sooner or later get his measure. If he is their master, they will know it, and if he is a pretender they will surely find him out.

There is no doubt that every red-blooded man likes to work under a boss who knows his business. It is the foreman who is not sure of himself who has the most difficulty and it is not at all surprising that this is so, for if a workman is obliged to take orders from a man whom he knows to be his inferior his work will lack the inspiration it should have. Commendation from such a foreman is small compliment and his criticisms often fall on deaf ears.

The foreman who is appointed, as sometimes happens, because there is no better to select and who is in no way better fitted to take charge than a number of his fellow-workers, has a hard row to hoe. The man who expects to forge ahead and stay ahead should build on something more sure than luck, or the friendship of someone higher up. If this means that he must study outside of working hours he should do so, for the results are worth while. It is hard to knuckle down after a full day's work to solve problems which may be of advantage only in the distant future, but that is the way to provide for the future. It is particularly hard for the young man who has many demands on his time, but if he will not prepare for the future between the years of twenty and forty by getting ready, he will stand only an average chance of preferment after that age. If he is ready his managers will sooner or later find it out and his recognition will come.

The writer knows of a concern which employed over one thousand men. Five of the employees of this concern decided that they would study at night and prepare for progress.

They were not at all men of special ability but they held themselves to the task and went ahead. Inside of five years four of them doubled their earnings and three are now superintendents. One quit too soon and he failed to go as far as the others. There was no favoritism about their risings for it was just a matter of course The opportunities were there and these men w re ready. The natural result followed. If men in the ranks would only realize that it was the natural result—the inevitable result—that these men should have been selected, more men would see the advantage of following the course which helped them. Not one of the four will say today that it was easy, but each of them will say that it was worth while.

Leadership cannot be taught. It must come from within a man or it will not come at all. A toolmaker once asked the writer if he would not always be supplied with the figure if he were told to turn up a bevel gear. He was intelligent and he was receiving good pay, yet he did not care enough about bevel gears to find out how to figure them. What chance then does he stand of being appointed foreman of a toolroom? Probably none at all, for he lacks the energy that is required of the man who is to have charge of others.

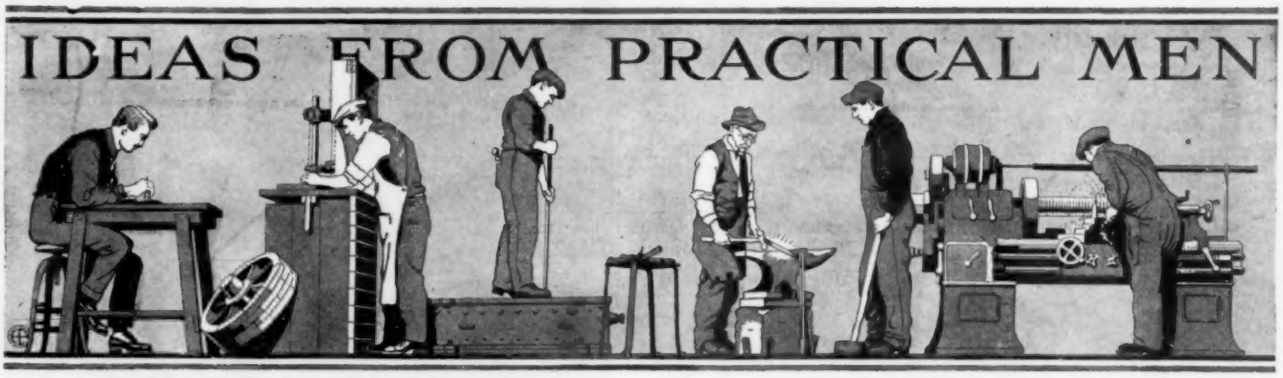
If a man expects to enter business for himself it is much easier for him to get a start if he has previously been selected for a position of responsibility by someone else. A foremanship gives him a standing that is of great value. The confidence and self-reliance which are needed are not developed over night but come only as the result of thought and self study.

In the reconstruction period which is upon us, the problems of management are coming to the front very rapidly and the supervision of labor is of greatest importance. New men are needed and there is only one place they may be found—in the ranks of the workmen. Who will be selected in most cases is he who is best prepared. Let him, who is hoping he will not be overlooked, remember that all things come to those who hustle while they wait, and that it is a question of what a man has to offer. not what he wants, that interests the manager.

A Boring Tool for Polygonal Holes

By E. A. Dixie

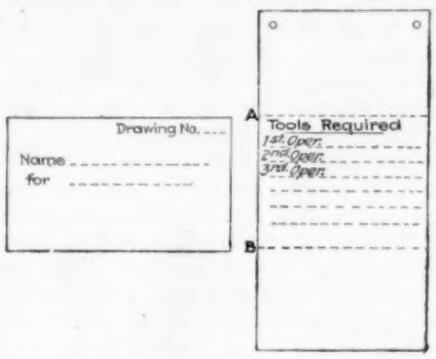
I have seen something very similar to the tool described on page 1246, Vol. 50 and I believe it appeared in the *American Machinist* some 10 years ago. It is impossible to judge of the practicability of such a device without seeing it, but except for very large holes there seems to be insufficient room for the gearing necessary to drive the horizontally disposed cutters. I believe there would be considerable chip trouble in some metals and it would also be impossible to finish a square hole to a bottom, as can be done with several of the square-hole boring devices which have appeared from time to time. After all, the cheapest way to finish a square hole is by broaching. Broached holes are also much more uniform than are those that are produced by any other method.



A Folder for Preserving Drawings While in the Shop

By F. N. Elmdorf

The sketch shows a folder for holding and preserving blueprints, drawings and sketches while in the shop, which may be of interest to those who have had the same experience as the writer in having prints come back soiled and mutilated. The folder is made of tough,



FOLDER FOR PRESERVING DRAWINGS

heavy paper and folded on dotted lines *A* and *B*. The drawings are secured to one end by means of clips or paste.

The center portion is arranged to show the tools required for each operation and sequence of operations. When folded it provides a convenient means for filing, the reverse side showing drawing number and other necessary data.

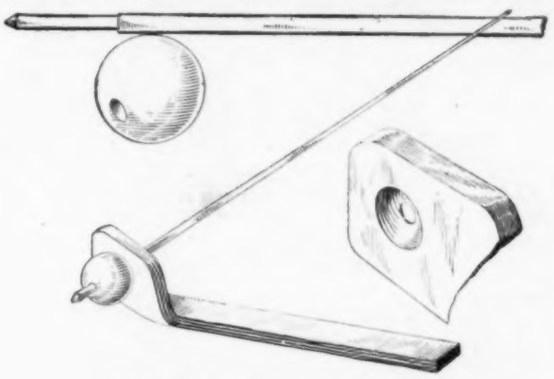
The folders can be made to suit any size print and make an ideal method of keeping prints clean and whole while in the shop

Simple Center Indicator or Wiggler

By A. R. Durant

Once, not being able to obtain a center indicator to locate a piece of work in a lathe chuck, I constructed the little tool shown in the sketch which not only served my purpose well at that time but has been equally serviceable many times since.

First I annealed a $\frac{5}{16}$-in. steel ball and drilled a $\frac{3}{32}$-in. hole through it, as near central as possible. Next, I put a piece of $\frac{1}{4}$-in. drill rod, 7 in. long, in the chuck of a speed lathe, filed one end down to slightly over $\frac{3}{32}$ in. in diameter for a distance of about $\frac{7}{16}$ in. and then pointed it. The ball was then heated to a faint red, the small end of the rod thrust through the hole to the shoulder and the ball allowed to shrink in place. A piece of $\frac{1}{4}$ by $\frac{5}{8}$ strap iron was now cut $4\frac{1}{4}$ in. long, and a $\frac{5}{32}$-in. hole drilled $\frac{1}{4}$ in. from one end and countersunk by a $\frac{5}{16}$-in. drill. This strip was then held in a vise, the drilled end rising $1\frac{1}{2}$ in. above the jaws and countersunk



SIMPLE CENTER INDICATOR

side to the front. With a wrench this was given a quarter twist to the left and then bent a little.

In operation the large end of the needle is slipped through the hole in the twisted piece, the ball setting in the countersunk socket like any center indicator. The iron strip or holder is held in the toolpost on top of a small lathe tool or upon shims and the carriage moved up until the point of the needle enters the center point, where it is held by the spring of the holder.

A Screw Machine Job on an Engine Lathe

By Owen W. Pullan

Having to make 400 valves like that shown at *A* in the sketch, and having no screw machine available at the time, I made a toolholder block for the slide rest of an 18-in. American toolroom lathe, which enabled me to finish the job in much less time than would be required by the ordinary method.

The block was adapted to hold a forming tool in front and a parting tool in back. The only other tool required was a $\frac{1}{4}$-in. drill, ground to cut the concave recess in the end of the piece.

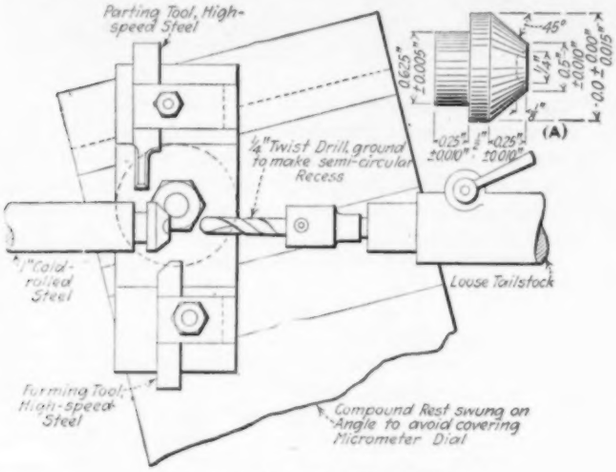
The material to be worked was 1-in. round cold-rolled-steel bar, and was held in a universal chuck from which it projected far enough to allow six or seven pieces to be cut off before requiring to be reset.

The forming and parting tools were made from $\frac{3}{8}$-in. square high-speed-steel toolbits, the front one being ground at the angle desired on the face of the work

while the parting tool is made $\frac{1}{64}$ in. wider than the $\frac{3}{8}$-in. diameter shoulder on the back. These two tools are so set on the tool block as to bring these two portions of the work into proper relation without traversing the lathe carriage.

The drill is held by a drill chuck in the tail spindle. The first operation is to bring up the tailstock, clamp it in position and drill in until the drill cuts full size.

The tailstock is then thrown back and the carriage brought into position to make the first cut by bringing the outer edge of the cutting tool in line with the end of the bar. The tool is then fed in until the smaller



THE WORK AND THE TOOLS

end of the angular face measures correctly with the micrometer, and the crossfeed dial set at zero. The cross-slide is then drawn forward until the shoulder formed by the parting tool reaches the required dimension, when the reading of the dial is noted. After these points have been established on the first one or two pieces, subsequent operations may follow quite rapidly; the bar being reset in the chuck after each six or seven pieces.

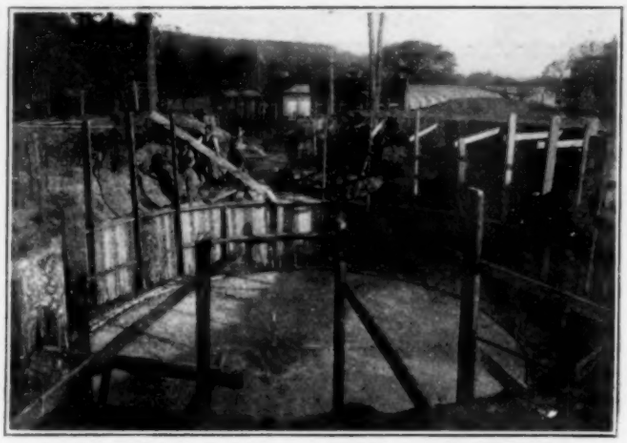
To cut off the piece the parting tool is backed out of the cut and the carriage moved along the shears until the side of the parting tool measures the proper distance from the shoulder; the cross-slide is then drawn forward and the piece cut off, at the same time squaring the end of the bar for the next piece.

The time taken to make the attachments was 4 hours, and the time on 410 pieces, including the time of making the attachment and the time of making and setting the tools was 26 hours or 3.81 minutes each.

Gravity Storage of Oil

BY PETER F. O'SHEA

When the United States Government requested manufacturers, who could do so, to order fuel oil in carload lots and to order it early so as to avoid freight congestion, the Greenfield Tap and Die Corporation, Greenfield, Mass., built a large oil storage tank at a point near one of their factories. The site of the tank is considerably above the level of the factory, as may be seen through the opening in the excavation shown in the illustration, though it is lower than the railroad tracks which run along the hillside in the distance. When a carload of oil comes in it is emptied by gravity into the storage tank.



SITE OF THE 42,000-GAL. CONCRETE TANK

A pipe line from the tracks to the factory was already in place, as the company had been using gravity transportation for many years to the former small tanks in the factory. It was, therefore, only necessary in the new construction to add a short extension from the factory pipe line to the new tank.

The tank was built of reinforced concrete made oil-proof. The floor is of concrete on a network of reinforcing, as is the top. The tank is 26 ft. in diameter and 11 ft. deep inside and holds 42,000 gal. When finished, it was covered with earth, and, as the pipe line is also underground, the whole arrangement is safe from fire and from all meddling.

Mixing the concrete and waterproofing has to be carefully done in order that the tank shall be oil-tight. The formula for the concrete mixture was obtained from the Factory Mutual Insurance Co., together with other information on the subject. The concrete is mixed 1 to 1½ of sand and 3 of aggregate, very wet, and carefully sliced to get out all air. The chemical waterproofing mixture was put into the water as the concrete was mixed and the result has proved that the tank is perfectly oil-tight.

Such a concrete tank seems to be economical for plants that can use oil in such quantities. The cost of a steel tank holding 10,000 gal. is from $1000 to $1200 while the cost of this concrete tank which holds four times as much was a little short of $2000.

Now the corporation has a supply of oil for a long time ahead. It is able to buy in carload lots and thus get a better price, not only in purchase of the oil but in the freight charges.

Base for Inside Micrometer

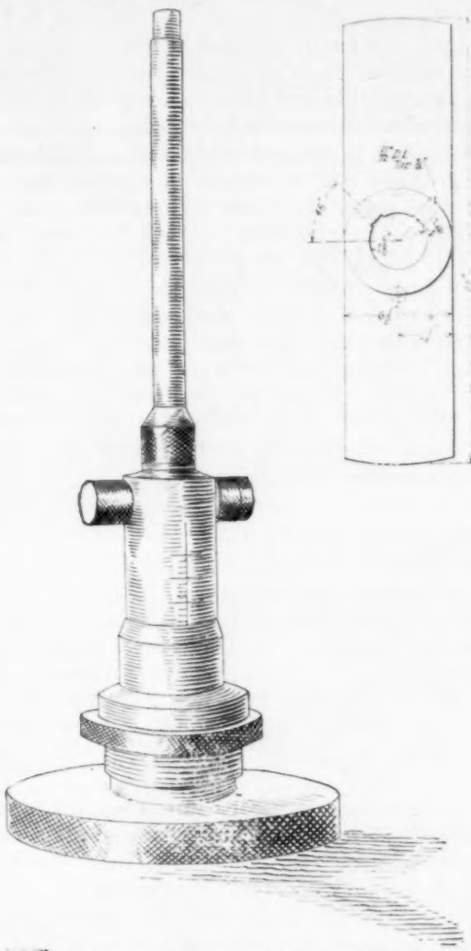
BY A. B. CHIARELLO

Here is a tool which I made for holding an inside micrometer in an upright position on the bench plate. In this position the micrometer may be used as a height gage either direct, as when the under side of projecting parts is presented, or as a means of setting the scriber of a surface gage. There are but two parts and the whole thing can be made on the lathe in a short time. The only material required is a bar end of cold-rolled steel, which can easily be found around the screw machine at any time.

The threaded part of the base is tapered slightly and the thread pitch is 40 per inch. It is slit in three places to allow for closing in when the nut is

screwed down, and horizontal cuts at the bottom of the slits as shown in the sketch facilitate this action.

The opening should be nicely fitted to the thimble of the micrometer, and after the piece has been pack-hardened it should be lapped smooth and true. Next, a piece of stock should be put in the chuck of a universal grinding machine and ground to the size and shape of the micrometer thimble. Without disturbing



BASE FOR HOLDING INSIDE MICROMETER

this piece in the chuck, place the finished tool over it and tighten the nut just as would be done to hold the micrometer. The bottom can then be ground true with the hole and there can be no question but that when the tool is later used on the bench plate the micrometer will stand truly perpendicular.

Forming a Ball on the End of a Rod

BY WM. OLDER

If Bernie Soule, who writes on the above subject on page 1141, Vol. 50, has a hollow mill of the correct size and will try it on the ball milling job, I think he will be better satisfied with the quality of the work. The trouble with the fly cutter is that the amount of feed varies with the distance of the cut from the axis of the rod. At the ends, that is to say the small diameter of the shank and the point supported by the tail center, the cut marks will be appreciably closer together and consequently smoother than they are at the full diameter or "equator" of the ball. While this will also be true with the hollow mill the tooth marks will be closer together and the result will be a better finish.

Crank-Turning Fixture

BY H. H. ESBENSHADE

It became necessary to produce the small cranks shown in Fig. 1 in large quantities and the method of turning wrist on a pair of swing centers was too slow. The inexpensive fixture shown in Figs. 2 and 3

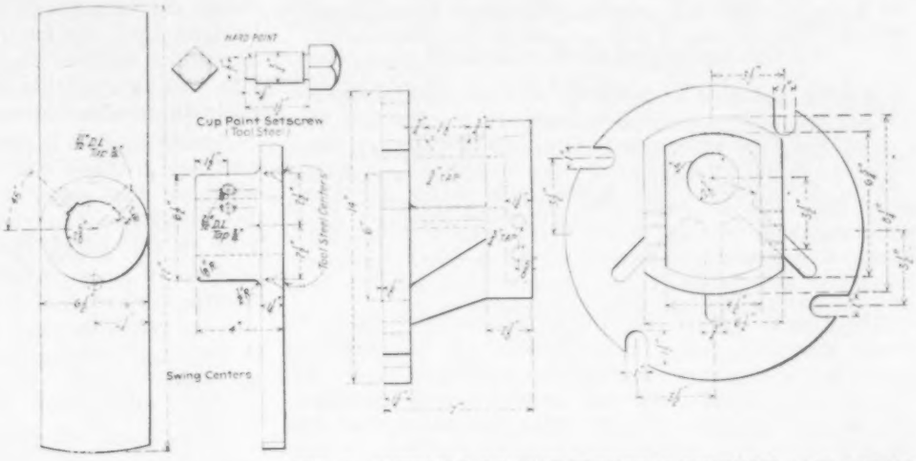
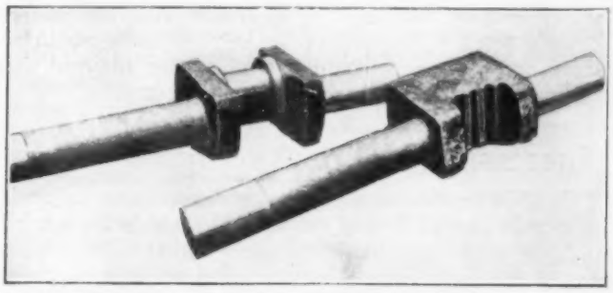
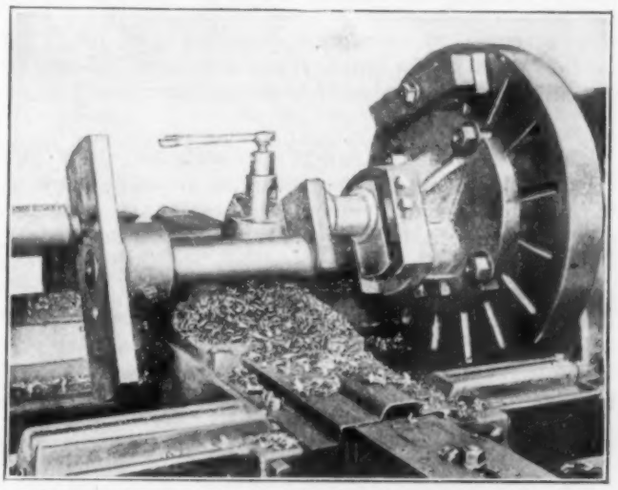


FIG. 2. DETAILS OF THE TURNING FIXTURE AND SWING CENTER

was designed for this work and proved satisfactory. The two ends of the shaft are turned to within $\frac{1}{16}$ in. of finished size and the fixture is bored a neat fit for the short end which is clamped rigidly in place with the setscrews. A swing center is used to steady the outer end of the shaft, as shown in Fig. 3. With this fixture the time was reduced from 2½ hr. to 50 min. and better work produced. Fig. 3 shows the fixture





FIGS. 1 AND 3. THE CRANKS AND THE WORK AND FIXTURES IN THE LATHE

EDITORIALS

"American Machinist" and Problem of Industrial Relations

MANY valuable and timely articles have appeared in the engineering periodicals during the last few months treating the subject of industrial relations from every angle. The subject is very properly one of the most vital interest just now when readjustment is in progress and we are endeavoring to forestall labor troubles by preventive measures.

* * *

The trouble is an old one, of course, but many of those identified with the representative or committee systems, as they are usually called, seem to feel that we have discovered a new way of attacking the problem. By reason of the naturally skeptical attitude of the more conservative toward anything that savors of innovation we have thought it worth while to print on page 301 a brief account of the work of H. F. J. Porter who ranks as a pioneer in the field. He instituted a committee system of works management which is fundamentally the same as most of the modern ones as long ago as 1903. And what is more, it worked so well that a factory with a most unsavory reputation was transformed into an object of local civic pride.

The columns of the *American Machinist* during the latter part of 1905 and in subsequent years show that the men who were guiding the destinies of the paper at that time were keenly alive to the possibilities of Mr. Porter's work. The only pity is that more manufacturers and managers could not have been induced then to give so promising a scheme an honest trial.

Increasing Use of Aluminum Alloys

THERE are indications that we may have to revise our ideas concerning materials available for various machine constructions. The endeavor to secure lightness in automobile construction, coupled with sufficient strength to withstand road shocks, has led to considerable development of aluminum alloys just as it has to the alloy steels, until these aluminum alloys are beginning to rival steel for certain purposes.

* * *

The aluminum castings of the early days were not very reliable, being, as one engineer recently expressed it, about as reliable under compression as a custard pie. But present-day alloys are very different in every way and in some cases aluminum castings in motor vehicles are standing the punishment of road shocks fully as well as the steel they replaced, and at a considerable saving in weight.

The very evident trend toward lightness in automobiles is hastening this development and a year may show some startling applications of aluminum alloys in motors and in the construction of the vehicle as well.

The price at present prohibits the use of aluminum in quantity except in special cases, and these seem to consume all the available supply. If, however, the claim be true that the earth contains three times as much aluminum as iron, there are hopes that greater quantities will be available and that all artificial restrictions as to its production may be removed.

Assuming that it can be produced at a sufficiently low cost, and that, weight for weight, it will be considerably stronger than steel, what are the probable uses for it in machine-tool construction? With increased perfection in the alloys and at prices which many believe possible, it could probably replace many parts now made of iron and steel if it were desirable to do so. What are the possibilities in this direction?

Flat-bed printing presses have been equipped with aluminum beds to reduce the inertia at each end of the stroke. Would it be desirable to make a planing-machine table or shaping-machine ram of aluminum were it practicable to do so?

* * *

The lightening of vehicles of all kinds is especially desirable owing to the possibility of securing reduced cost of transportation thereby. Railroad passenger cars seem to grow heavier from year to year and add to the cost of haulage. The substitution of aluminum for truck frames and car bodies might reduce the weight by half while retaining sufficient strength for emergencies. The question of price seems to be the great drawback when we consider its substitution for iron and steel.

How far is weight necessary in the base of a machine tool to absorb vibration or can we reduce the amount of vibration to be absorbed?

If weight is not necessary, the saving of from one-half to two-thirds of the weight of machinery would make possible much lighter construction in shop buildings. And with an additional saving in weight due to more of the lighter metals being worked on, the cost of multi-storied shop buildings could be considerably reduced.

This is not prediction—it is merely speculation. But some recent developments seem to make some of it at least a possibility.

Consider the Other Fellow

INCREASES in wages and in living costs leave us, for the most part, very little better off than before. Some of those in the middle classes are actually worse off than before. And there seems to be very little relief in sight.

It is time for some A-B-C thinking in economics—for the war has not made it possible to get something for nothing—and nothing ever will.

We must come to see the close relation between all industries, to know that equitable distribution is just as important as production. We must also realize, and make others realize, that no plan of distribution will give us plenty unless we produce enough to go around. We must consider the other fellow as well as ourselves.

The Machine Industry in England and France

(By A. C. COOK)
Sales Manager, Warner & Swasey Co., Cleveland, Ohio

We are all interested in the condition of the machine industry in England and France. Here is a first-hand report by a keen observer who has recently returned from abroad.

BY government order, British machine-tool makers were compelled, during the war, to paint their machines with a "standard" paint of dirty red color, which was known as "war finish." They were not permitted to fill the castings, being allowed only to clean them of the sand. This accounts for the stories we heard of British machines in continental factories being painted red to make them distinctive. During 1916, 1917 and 1918 no machine tools were exported from England.

In 1914 the British machine-tool output was valued at $20,000,000, while in 1917, on the same basis of figures, it reached $32,500,000, the balance of requirements being imported in vast quantities. To March 1 prices had increased an average of 55 per cent., most of which took place before the government relinquished control of the industry. When the government relinquished control, prices of some machines were advanced further. It is stated that the official German figures give their 1914 output as $82,500,000 and for 1917 as $100,000,000.

Wages in machine-tool shops have increased greatly. In 1914 the rate of the Amalgamated Society of Engineers (the machinists' union) was $9.12 for a 55-hr. week, plus a bonus (most shops being operated on the bonus system). As nearly all shops work with the union, this rate was the standard for practically the entire trade, varying slightly in certain localities with the cost of living. After conferences, the Employers' Federation and the A. S. E. agreed upon a day rate of $11.04 per week, plus the bonus, this latter being figured on the old rate of $9.12; that is, the bonus times were left unaltered. During the war, the government forced the employers to reduce the working hours to 47 per week, and to raise the rate to $16.08 per week. To this amount must be added the bonus (averaging 30 per cent.) based on the $9.12 rate, and an additional 7½ per cent. (on the total of the day rate and bonus), this later also being forced by the government. This gives an hourly rate of 43 cents and a total of $20.21 as the total wage for a 47-hr. week. Each shop sets the production time for its own work, and the 30 per cent. is the average. Toolmakers are paid a slightly higher weekly rate and receive the same bonus as machinists. Overtime must not exceed eight hours per week, and is paid for at time and a quarter; in most shops men refuse to work overtime.

The wage increases were usually given in 1½ per cent. raises, and for each five of these, totalling 7½ per cent., the makers were allowed 4 per cent. increase in prices. Originally, manufacturers were permitted to make the same percentage of profits as in either 1912 or 1913, where this profit was reasonable. Experts were sent to some shops to examine costs and prices and manufacturers were allowed to make increases (in addition to the above) if the case warranted it. The 7½ per cent. bonus added by government orders may be taken off, but if so, the day rate may have to be increased to make up for it. Prices probably can not be reduced in any machine-tool line.

There is some sentiment among machine-tool makers for a protective tariff on imported machines, and it seems probable that a small duty—say 10 per cent. or 15 per cent.—may be put into effect within a year. These manufacturers feel that British machine tools are as good as American machines and that on an equal basis they can easily compete, but they resent the fact that America has a tariff against them. There will probably be a general election this fall, and the tariff plank may figure largely in the platform of some party. Newspaper sentiment is divided, some favoring free trade, and some a tariff.

It is practically decided to hold a machine-tool exhibition at Olympia, London, in 1920, similar to that held in 1912. The details are not yet decided.

Iron and Steel

During the war England almost doubled her steel-making capacity. In order to keep down the prices of pig iron and steel, the government paid, from January, 1916, to May, 1919, subsidies amounting to $243,000,000 on iron ore, coke and pig iron, amounting on the pig iron to about $12.50 per ton. This subsidy followed wage increases to miners and railroad men. The control of the industry was in the hands of the government, but the control and the subsidies were both withdrawn May 1, 1919. The controlled price of Cleveland pig iron was $23.75 per ton, but it is now quoted at $35. In other sections the increase ranges from $16 to $20 per ton. Thus, while the price of American iron has been reduced 22 per cent. the English price has been increased 25 per cent. on the average. Even so, very few producers are quoting far ahead, as they are not sure of future prices, and the producers have agreed to specify in quotations that iron shall be invoiced at prices in effect at time of shipment. Prices now are approximately 2¾ times the 1914 level, but it is assumed that these high prices are not likely to curtail consumption. A number of sellers, in making contracts, figured on the withdrawal of the government subsidy, so buyers expected the increases, and planned accordingly. No sudden reduction can be expected, particularly while living costs are at their present height. Finished steel is quoted up to $25 per ton.

Iron is still imported only under license, and it is expected this will continue until some protective measure is passed by Parliament. England produces two-thirds of the iron ore she uses, and imports the balance, principally from Spain and Sweden. There is some talk of developing further the iron deposits of the empire. A policy of imperial preference has been decided upon by the government, and imports of iron ore from the colonies would come in either free or at a very low rate of duty.

The recent reduction of $4.25 per ton for American pig iron and $12 for finished steel startled the English market. It was noted that the American price was $38.50 for 4-in. billets, compared with the English price of $60. The freight from America of $30 additional delivered to the consumer is not conducive to importing steel into England now, but in the outside export market the competition cannot be on so nearly equal a basis.

The order for tram rails recently placed with the Lorain Steel Co. by the City of Birmingham caused a great deal of comment. It is felt that the British rail market should have had time to re-organize their works on a peace basis. The British quotations on this order were for higher prices and longer deliveries than the American quotation. Before the war, tram rails were imported into England from both America and Belgium, so this recent order was nothing new. Ship plates have, for years, been imported from Belgium to the Clyde; in fact this trade was so large that specially constructed boats were used to handle it.

On Mar. 15 the Ministry of Munitions had on hand in the United Kingdom 80,000 tons of pig iron and 70,000 tons of shell steel billets suitable for re-rolling, in addition to 70,000 tons of billets in America and 168,000 tons of steel in different forms in Canada. All this is to be shipped to Great Britain and placed at the disposal of the steelmakers for re-rolling or for scrap, except where the American and Canadian stocks can be more advantageously disposed of there. At present there is a shortage of scrap.

Some rolling mills are changing from the former 12-hr. shift to an 8-hr. shift, and report an increase per hour of 20 to 30 per cent. During the war wages in the steel industry have been increased about 100 per cent. and hours reduced about one-third.

Conditions as to Export

A great deal of England's prosperity has always come from her export and re-export trade. With all her industries for the last four years turned over to the making of war material, it is not surprising that markets which she formerly looked upon as distinctly her own are now being supplied by America and Japan. Her former low costs enabled her to quote prices which no competitor could touch; now, with constantly increasing costs to face, the outlook is not encouraging. For example, Japan is making progress in the production of textiles, and is cutting into England's textile trade, which is causing a great deal of concern in the Lancashire district. The Japanese competition is said to be more serious than was the German, and the markets of India and the Far East are turning to Japan for textiles. In one case cited, the Japanese selling price was cheaper than the English cost. The newspapers try to assure the British manufacturers that while their trade may be smaller in some places it is probably increasing in other districts; also that Japan possesses no more spinning mills than are to be found in any one of the larger Lancashire towns; and that from the products of these mills the home trade must be cared for ahead of the export trade. It is admitted that the Japanese product is growing better in quality, colors and variety.

Japan is becoming a serious competitor in the brush trade as well, and it is claimed that it is because of the British manufacturer's slowness to increase production by automatic machinery.

Formerly the Lancashire textile machinery manufacturers exported to practically all the world, even to America, in spite of the 45 per cent. duty on their machinery. Now American manufacturers are quoting within 2 or 3 per cent. of the English prices in Italian, French, Belgian and other markets. Prior to 1914 England exported $40,000,000 worth of machinery annually. There is a great deal of textile machinery to be built for the British factories, and these shops are now being changed back from their war products.

England formerly exported vast quantities of coal. Now America is cutting into this trade in South America and Europe. American coal was recently offered at $5.80 at Newport News, which is less than half the cost of Welsh coal at Welsh ports. Since April 1 American coal is being delivered to Switzerland via the Rhine at lower prices than coal from England or the Ruhr region of Germany. (Further reference to coal is made under "Labor.")

England still continues her investments in South America. Recently a British syndicate was formed with a capital of $10,000,000 for the purpose of developing some of the iron deposits in Brazil, and possibly shipping some of the ore to England. Brazil is considering a proposal to impose a condition that for every thousand tons of ore exported, a specific quantity of steel should be manufactured (by the exporters) in Brazil. This should lead to development of the metal-working industry in Brazil.

Last year England sent a mission to Brazil to study trade relations with that country, the commission being headed by Sir Maurice de Bunsen. The visit is now to be returned by a party from Brazil who are to be guests of the Federation of British Industries, an export association. W. S. Barclay, of the Federation, has gone to Brazil to conduct the committee to England. At the end of the tour the Federation will send a permanent commission to Brazil.

British manufacturers are giving serious thought to the regaining and expanding of their foreign markets. To this end several associations have been formed. Two of them, the British Manufacturers' Corporation and the Federation of British Industries have combined in one body. The British Manufacturers' Corporation has a membership of 300 firms, and the Federation includes over 800 firms and 170 trade associations. It is proposed to appoint a commission of high commercial standing in foreign markets to act as advisors and to collect information regarding foreign trade.

The Anglo-Chinese Engineers' Association has been formed by 42 non-competing firms of British engineers to work in China. Another company, which has as members some of the leading English manufacturers and shipbuilders, and known as Representation for British Manufacturers, Limited, is to operate in China and eastern Siberia. In addition, a great many trades and industries are forming export associations to secure for their members data regarding the different exports fields, and to actively take up sales work for their members only. Most of these associations are non-competing.

The subject of export was taken up at the recent annual meeting of the British Chamber of Commerce. The president, in his annual address, pointed out that high wages and shorter hours would cause the loss of a great deal of trade unless production was increased at least in proportion to increased wages. He mentioned that already in some industries men are producing smaller outputs than before the war.

The Automobile Industry

It was but natural to expect that some of the automobile builders had, during the war made airplane engines. One of them (Siddeley-Deasy Co.) even made complete airplanes. Others made trucks and passenger cars for the army, while the Austin Co. made shells, forgings and fuse parts, in addition to armored cars. All are faced with the problem of utilizing their increased capacity, and some have announced their post-war plans. Practically all companies are making high-priced cars, but are striving for "quantity production" which does not seem possible (as we know it) at the prices quoted. Austin will make a so-called medium-priced car to sell at $2425. Other makers price theirs all the way up to $5000 for the chassis alone. Austin will endeavor to produce 30,000 cars, of which they claim to have orders for some 20,000.

Undoubtedly, the uncertainty regarding prices for labor and material figure largely in these prices, which, on prewar makes, are about 60 per cent. higher than in 1914. Some are nearly double. While the makers are undoubtedly serious in their efforts for business, they are leaving the largest market—from $1000 to $1500 to the "light car" makers. Very few six-cylinder cars are made; only one eight-cylinder is advertised and no announcement regarding the twelve-cylinder has appeared. All the old established manufacturers are planning for larger output than before the war, which was about 3000.

The principal new company to build cars will be Cubitts, Ltd., who before the war were erectors of steel and concrete buildings. During the war they made immense quantities of fuses, and decided before hostilities ceased to take up the manufacture of cars. In addition, Sir Wm. Angus, Sanderson & Co., Newcastle, are to put on the market the first "assembled" car, with units built to their specifications. This car will sell for $2250, and this year's production is planned at 6000.

British automobile manufacturers have never seriously tried to secure foreign business, as they felt that the trade demanded a type of chassis which would not appeal to the home market. They now recognize that the home demand cannot take up the possible production from their present factories, as some have been increased many times their former size, and they are studying the export field.

The Research Association of British Motor and Allied Manufacturers has recently been formed to conduct research work for the members. It comprises a great many of the larger builders. The government will contribute $25,000 per year, being one-half the estimated expenses for this work.

For two years the import of motor cars has been prohibited. Now, foreign makers are allowed to send in, each month, at 33⅓ per cent. duty, a number equal to 50 per cent. of their imports for the corresponding month of 1913. This to be effective up to Sept. 1, when the situation will be reconsidered.

The machine-tool buying by automobile companies is only of machines to balance up their present equipment; thus, for instance, Cubitts bought large presses for radiator shells, etc., selling their war equipment at low prices. Parts for assembled cars are purchased from makers who have practically all the necessary equipment.

Large numbers of tractors will be built, mostly by companies engaged in engineering and agricultural-machinery manufacture. They are mostly buying various units which they are not equipped to make, although some companies are putting in equipment to balance up their shop for the new work. A tractor exhibition was held in July.

An automobile show will be held in London next fall, being the first since 1913.

The automobile market should be very good. No new cars for civilian use were made during the years from 1915 to 1918, and none could be operated except for business, as gasoline was strictly licensed. The license is not now required. Second-hand cars are bringing very good prices.

Labor Conditions

"The attitude of labor" has always been an everpresent subject in England. The unions are very strong, and contain about 75 per cent. of the labor element. In the past the position of employer and employee has been that of "master and man." The position is improving in that both are endeavoring to coöperate.

Wages are much higher than in 1914, and this has, of course, been reflected by higher costs in every line. During the war the government took control of many branches of industry, and effected wage increases, following which some industries were subsidized to keep down prices to the consumer. It is next to impossible to reduce wages, first because the cost of living has not come down sufficiently, and second, because of the power of the unions. These "societies," as they are called, are recognized by most employers, and union conditions prevail in the majority of shops. There were two outstanding points in labor's program which the war made possible of enforcement; namely, shorter hours and higher wages. The standard working week now varies from 44 to 48 hours with weekly wages no less than when the week was 55 hours. It now looks as though Parliament will make compulsory at least a 48-hour week in those trades now working longer hours.

At the last general election, leaders of several unions were elected to Parliament—Messrs. Thomas of the Railway men; Smillie of the Miners; Clynes of the General Workers, etc.—so that labor now has greater power than formerly. It has also sympathizers in the government itself.

At one time in the early part of 1919 it seemed that England was heading toward industrial chaos. There were strikes in a number of leading industries, in all sections. Generally, these strikes were authorized by union leaders, who seemed to have lost their power over the men, and who were quick to recognize the harm such strikes would do the cause. The government finally called a meeting of representative employers, labor leaders and government officials to consider the larger questions involved. This was the first meeting of its kind ever held here, and following it committees were appointed to consider the various questions which were raised, and to report at later meetings. These meetings will do a great deal of good and should promote much better feeling between employer and employee.

The Unemployment Bonus

Demobilization plans were ready at the time of signing the armistice. A great deal of unemployment was expected temporarily, and accordingly an "unemployment bonus" was established for demobilized soldiers and munition workers, this latter class including practically everyone who had been in any work connected with the war. It was put into effect Nov. 21, 1918, and was to operate for 13 weeks, at the rate of $7 per week for men, and $6 per week for women. It was then to be reduced to $4.80 and $3.60 per week, respectively, and to end May 21, 1919. In addition to the amounts named, certain small additional sums were granted under certain conditions. It has now been decided to extend this bonus to Nov. 21, 1919, but no one is to draw it for more than 26 weeks in any one year, except unemployed soldiers, who are to receive the bonus for one year after their discharge.

All unemployed receiving the bonus must register with the Labor Exchanges and take any position offered for which they are suited which pays as much as the bonus. Instances are cited in which people register at the Labor Exchange for work which they did during the war, with the knowledge that no position can be found for them in that line. Thus, a man who was a wood-working-machine hand before the war was an airplane spar maker during the war, and registered as such. In a great many cases both men and women have been cut off from the bonus for a number of reasons, but at present over 1,250,000 people are on the list, drawing a total of $6,250,000 per week. About 4,000,000 people have been demobilized from the forces and from munition works, and the government claims that nearly 3,000,000 are now back in other employment.

Merchant shipbuilding is going on at a good rate; 100 cargo steamers of between 3000 and 7000 tons have recently been ordered by Norwegian firms. Naval building is not so brisk, the Admiralty having recently issued instructions to suspend work on a number of destroyers under construction on the Clyde. It is expected that orders for these boats will eventually be canceled.

Lloyd's figures at the end of March show that England is not doing as large a percentage of the world's shipbuilding as formerly. On Apr. 1, out of a total of 7,800,000 tons building in all countries, America had 4,186,000, while the United Kingdom had only 2,250,000. In July, 1914, the United States had only 149,000 tons to the United Kingdom's 1,700,000. Only 205,000 tons were launched in the United Kingdom in the first quarter of 1919. Building costs are still rising while American costs are being reduced, although still higher than Great Britain's, which country is giving considerable thought to the subject. Up to now the "fabricated" plan has not been tried here.

A great many things formerly imported (particularly from Germany) are now being made in England, such as dyes, hosiery, etc. Steel for wire was formerly imported from Germany and Belgium, but now automatic drawing mills produce 1500 tons per week with the same staff formerly required for 35 tons per week. This is another indication of the awakening to the advantage of automatic machinery, although there are still a great many trades which have not realized the advantage of improved methods.

Reconstruction

Reconstruction is not getting under way as rapidly as was anticipated nor as rapidly as the British manufacturers had hoped. This is due to several causes, probably the largest of which are the control exercised by the government (until May 1) over raw materials; uncertainty regarding costs of labor and material; uncertainty regarding the excess profits tax. The first cause was removed May 1, when government controls were removed from metals, but with the approval of that control iron and steel prices advanced. The second cause has not yet been entirely removed; probably labor's attitude will be the same in a year as it is now—so prices of finished products must be set high enough to compensate for such increases as it may seem necessary to make. The third cause—excess-profits tax—has been only partly removed, having been reduced from 80 to 40 per cent.

With some companies, iron and steel manufacturers, for example, reconstruction does not mean much change of product or equipment; their problem is to find business to keep their equipment busy. With others it means a complete change of manufacturing program. Thus some munition shops are taking up the manufacture of automobile parts and accessories, while some are to make complete cars—Cubitts, for instance. Some companies, which have always been known as "armament firms," fear the result of any reductions of armament under the League of Nations. In Sheffield alone there are four companies of this

class, 50 per cent. of whose peace-time products were for war. Sir W. G. Armstrong, Whitworth & Co. and Vickers, Ltd., are also in this class, and their post-war plans are fairly well known. Both are placing some of their funds in outside shops in various lines. Thus Vickers own either outright or a control of British Westinghouse Co., Sir Wm. Beardmore & Co., Electric and Ordnance Accessories Co., Petters, Ltd., Metropolitan Carriage and Wagon Co., Arrol-Johnston Co., and several others. They have just taken some stock in a new match-making combine, and will build their machinery. Their peace program will include the manufacture of pianos, sewing machines, toys, locomotives, trucks, ships and machine tools. They have just erected a plant for making 12 tons of files weekly. They have also started to make vehicle springs and drawn steel tubes. Their outside interests bring them into touch with practically all lines of business, either through their stock holdings or through their directorate. One of their directors is on the Board of the Bank of England, and another is a member of the Board of the Midland Railway. Vickers is probably the most widely connected industrial company in England.

Increasing Range of Products

Armstrong-Whitworth announce that they are preparing to deal with a wide range of commercial engineering; build locomotives (300 or 400 per year); manufacture machine brass and steel castings forgings (rough and finished); manufacture pneumatic tools, a "general line" of machine tools, and marine engines. They expect to take a large part in the reconstruction of Belgium.

Hadfields, of Sheffield, have just completed, at a cost of $2,000,000, a new forge shop, heat-treating and machine shop, and are preparing to take on rough and finished forging work up to 12 or 14 tons. It will be remembered that this company was the successful bidder for U. S. Navy projectiles several years ago. It is significant that all the large steel mills are adding to their capacity in furnaces and rolling mills.

Evidence of a new era in the British manufacturing work is seen in the combinations now being formed in various lines, such as were formed in America a number of years ago. Thus, the United Steel Co., Ltd., recently formed from five separate companies, own and operate coal mines, iron mines, blast furnaces and rolling mills. Some other combinations have been formed in iron and steel, though not so far-reaching as the above. Several of the big agricultural-implement firms have bought control or amalgamated with firms in similar lines. A new electrical manufacturing company, styled "The English Electric Co., Ltd.," includes the Coventry Ordnance Works (whose principal product now will be small motors); Dick, Kerr & Co. (contractors for large electrical installations); Phoenix Dynamo Works (large motors and dynamos); United Electric Car Co. (electrical street cars), and Williams & Robbins (large direct-connected engines and turbines). All these combinations are looking toward better manufacturing facilities and reduced costs.

It is rumored that the leading American steel makers have opened negotiations with the leading English makers in the same lines with a view to the establishment of an international agreement for pooling exports, and also for the regulation of prices, to secure to each country its home markets, and to work in harmony in the foreign markets.

Production of war materials has taught manufacturers not to fear "quantity production." This will be followed up wherever possible. For instance, one gasoline-meter manufacturer advertises 12,000 automobile engines, all alike, to be produced in a certain time, at a fixed price regardless of changing conditions in that time. Before the war such a quantity was unheard of. Production methods are also changing. Work is being taken from hand machines to automatics, and from engine lathes to hand screw machines and turret lathes. Every manufacturer is investigating automatics wherever possible.

The reconstruction plans of the French government contemplate protecting the machine-tool industry which has developed during the war. Compared with American shops the production is not large, but the makers are demanding protection. It seems to be the consensus of opinion that France (and Switzerland) will build nearly all the small lathes, shaping machines, planing machines and upright drill presses for the French market, and that few of these machines will be imported in the future. (It is interesting to note that the Oerlikon Machine Tool Co., Oerlikon, Switzerland, built six large milling machines of the Ingersoll type.) Some few small screw machines have been built in France and Switzerland, but it seems likely that their manufacture will be given up.

During the war the importing of machine tools was possible only under a government license, and at a regulated profit of 15 per cent. over the price at New York. This price control has been removed, but the import restrictions are still in effect. When these import rules were first put into effect, some of the native French importers (Fenwick, Chounard, etc.) asked the government to form a bureau to take control of the situation, which resulted in the creating of the "Comporti d'Achat des Machines Ouitla." The French importers were well represented on this Compoir, but the "foreign" dealers were not represented at all. The French dealers found that working with a government department entailed a great deal of red tape, and after the armistice asked to have it dissolved. Meantime, the foreign importers formed an association similar to one formed by the French importing dealers before the Comptoir was formed. These two associations now work together for the common cause.

The Ministry of Reconstruction requested the two associations for advice as to the amount (in francs) of machine tools which their members wanted to import during 1919. Each dealer submitted his figures through his association, these figures being reduced approximately one-half by the government. In addition to the amounts allotted to the associations, certain large firms will be permitted to order and import direct. When a government department places an order direct with an importer, the amount of such order is not deducted from the importer's total permit. Following are the figures for 1919:

Total importation of machines and tools	$46,800,000
From America	$27,200,000
England	12,000,000
Switzerland	7,600,000
Total	$46,800,000

This is not all machine tools and small tools, but includes some agricultural machines and general engineering machinery.

Manufacturers located in the invaded districts who wish to purchase equipment on long terms can make such purchases through the Ministry of Reconstruction, obtaining long credit. The Ministry arranges terms with the importer who supplies the equipment.

Allied commissions searching the occupied portions of Germany for machinery, etc., stolen from France and Belgium estimate that of the material and machines taken, only 10 per cent. can be removed in good condition; 15 per cent. is useless, and the balance has been totally destroyed. The stolen material and machines was handled through a German government department called "Womba" which was especially formed by the war department for this purpose.

Helping Reconstruction of Shops

In the invaded district of France alone 40,000 to 50,000 machine tools were stolen or destroyed. A plan is now being considered for turning over to the French government all machines now in possession of the American government in France, these numbering some 5000 or 6000. It is obvious that a great amount of equipment must be purchased for the invaded district. A great many companies from this district moved to the southern part of the country and started anew. It is a question as to how many will return to their old locations for while the French government will reimburse them to some extent for their losses, the amount they obtain thus probably will not be large enough to justify moving north again.

Railways and their motive power and rolling stock are in bad shape. The government has asked the various large factories as to their ability to both build and to repair locomotives and cars. They found capacity for repairing 6000 cars per month, while there are some 400,000 cars to be repaired. It is possible that the repair equipment sent to France by the American Government may be used in this connection, but some large shops, such as the Renault shop, are investigating the question of these repairs. In fact, at one time, Renault sent out inquiries for locomotive-repairing machinery.

New Lease of Life for Automobiles

The automobile is to have a new lease of life. The former manufacturers have been making war material, as well as trucks and passenger cars, and are extending their activities to provide use for their equipment. Berliet is to make a car selling for $2500, while Renault is to manufacture a $1500 car, which will be complete with all equipment. Andre Citroen, originator of the herringbone gear, started in 1914, in a very modest way, to make shells, his original contract being for 50,000. Eventually, their production reached 50,000 per day, and in addition they made fuses, forgings and other articles, employing some 16,000 people. Now this plant is to produce a four-cylinder car selling for $1600. Their schedule calls for 100 per day, and they claim to have sold 20,000 of the first year's production of 30,000. They planned to start on the 100-per-day schedule on Mar. 24, but the writer was in their shop one week before that time, and the machinery was standing idle. The toolroom was running, and they were experimenting with making steel frames, but otherwise nothing was being done. They had to buy a good deal of equipment to balance up the shop, such as gear-cutting machines, etc. Probably 100,000 cars will be produced in France this year.

When peace is finally signed, France will be in possession of more coal and iron than she has had for years. It is logical to expect that she will export rather finished products than raw material, although she will export some of the latter, as her home requirements will not be great enough to use all of it. Before the war she exported both iron and coal. The mines being worked largely by foreign labor. There seems to be some question regarding the possibility of again securing this labor, and some thought was given to using the Chinese labor which was used for war work. This Chinese labor is not profitable, compared with the labor formerly used.

A large program for expansion of transportation facilities is being considered by the Department of State for Public Works. It is proposed to extend the docks of the ocean ports to receive the largest ocean liners, particularly at Brest and Marseilles. Even Algiers harbor is to be improved, and facilities are to be provided for bringing coal from the Saare Valley, and finished products from Alsace to the Mediterranean. A bill will be introduced to make Paris a seaport.

The Paris-Orleans Railway Co. and the Paris-Lyons-Mediterranean Railway Co. plan to electrify 5500 miles of their lines, producing electricity by water power. It is estimated that machinery to the value of 40 or 50 million dollars can be released from American and French shops and arsenals, for disposal among French manufacturers, but up to date no such sales have been made.

Tractors to Replace Horses

A number of tractors will be made in France. Practically all farm horses have been killed in the North. Some tractors have been imported, but in March further importation was prohibited indefinitely. This prohibition will undoubtedly be withdrawn later, but meanwhile agriculture is held up to some extent. The government has arranged to finance the purchase of tractors for groups of farmers in the invaded districts. In some sections the old trenches of the battlefield are now being filled in so that the land can be cultivated.

Freight before the war was only $10 per ton, instead of the present rate of $35. Insurance has, of course, been very high, but is now only 1 per cent. These rates have tended to increase the prices of machines, and as the rates are gradually reduced and as exchange reaches normal, prices will be readjusted accordingly.

The Minister of Reconstruction announces that State workshops will be used to repair railway cars and to build new rolling stock. At the end of April cars were being repaired at the rate of 1500 per month, and by the end of June the figure will reach 2500. The government is considering the manufacture of telegraph and telephone instruments and appliances. It recommends that hydraulic power be developed, which would save 8 to 10 million tons of coal per year, and keep perhaps $100,000,000 in the country which pays for the coal now imported.

Iron Ore Extracted by Germany in France

It is estimated that Germany extracted 14,000,000 tons of iron ore from the invaded regions of France as against 83,000,000 tons which would have been the normal production.

The Minister of Reconstruction, Mr. Loucheur, has stated that the restoration of the invaded regions will require $15,000,000,000 and pensions an additional $8,000,000,000. These figures are claimed by some to be low; they estimate the cost of the war to France to be $63,000,000,000.

Sales Organization of the War Department

The names and addresses of the chiefs of the various sales organizations directly connected with the disposal of the War Department's surplus materials are divided into the following groupings:

I. Office of the Director of Sales.
II. War Department Bureaus located in Washington.
III. War Department District Sales Offices.

I. Office of the Director of Sales, Munitions Building, 19th and B Sts., N. W., Washington, D. C.

Director of Sales, C. W. Hare, Room 2042; First Assistant Director of Sales, E. C. Morse, Room 2044; Assistants to Mr. Morse, Maj. W. M. Crunden and Maj. H. S. Johnson, Room 2046; Assistant Director of Sales, Guy Hutchinson and A. L. Mercer, Room 2048.

Sections and Their Chiefs

Adminstrative Section, Maj. C. S. Shaw, Room 2050; Contractors' Railway Equipment and Building Material Section, W. P. Gleason, Room 2512; Plant Facilities Section, W. G. Sloan, Room 2510; Machine Tools Section, Chas. Hildreth, Room 2047; Motor Vehicles, Vehicles and Aircraft Section, Lieutenant Vandevanter, Vehicles, and Captain Dissetts, Aircraft, Room 2513; Quartermasters' Stores Section, Maj. E. E. Squier, Jr., Room 2502; Ordnance and Ordnance Stores Section, Maj. P. S. Senior, Room 2514; Raw Materials and Scrap Section, Maj. Wm. Wilson, Jr. and Maj. M. J. Connolly, Assistant, Room 2507; Sales Promotion Section, B. A. Mattingly, Room 2515; Contract Section, Maj. Victor E. Ruehl, Room 2501.

II. War Department Bureaus Located in Washington

Ordnance Department, Sixth and B Sts., Building B; Salvage Board, Chairman, Col. D. K. Shurtleff; Secretary, Building and Equipment, Maj. G. C. Hicks, Jr.; Secretary, Committee on Sales, Maj. A. G. Peter.

Office Director of Purchase and Storage: Salvage Division, Munitions Bldg. 1336, Colonel Nixon; Surplus Property, Munitions Bldg. 1107, L. Birkenstein; Waste Materials, Munitions Bldg. 1321, R. Cunningham; Chemical Warfare, Sixth and B Sts., Bldg. F, Maj. F. E. Breithut; Construction Division, Sixth and B Sts., Bldg. C, Lieut.-Col. Wm. Couper; Military Aëronautics, 4½ and Missouri Ave., Bldg. D, Maj. Harry Graham: Aircraft Production, 4½ and Missouri Ave., Bldg. D, Capt. C. S. Shotwell; Signal Corps, 18th and Virginia Ave., Capt. W. S. Kelly; Engineer Corps, 7th and B Sts., Bldg. C, Maj. W. W. Houston.

III. War Department District Sales Offices

Baltimore—Ordnance, 110 East Lexington St., Capt C. G. Wollson; Salvage Board Commission on Sale of Materials, Bartlett-Hayward Co., Columbia Ave. and B. & O. R.R., Lieut. J. V. Potter; Chemical Warfare, Edgewood Arsenal, Edgewood, Md., Maj. A. M. Heritage; Official Director of Storage, Waste Materials Branch, Coco Cola Bldg., Captain Weyman; Official Director of Storage, Surplus Property Division, Coco Cola Bldg., Capt. H. C. Owen.

Boston—Ordnance, 19 Portland St., Maj. R. E. Friend; Salvage Board Commission on Sale of Materials, 19 Portland St., Lieut. D. E. Dube; Official Director of Storage, Waste Materials Branch, Army Supply Base, Lieutenant Fliney; Official Director of Storage, Surplus Property Division, Army Supply Base, Col. Wm. H. Hart; Aircraft Production Board, 811 Little Bldg., Lieut. David Heald; Signal Corps, Textile Bldg., Colonel Hartmann.

Bridgeport—Ordnance, 945 Main St., Maj. E. T. Walsh; Salvage Board Commission on Sale of Materials, 945 Main St., Lieutenant Peters.

Buffalo—Aircraft Production Board, 2500 Elmwood Ave., Capt. H. Haimon.

Chicago—Ordnance, 155 East Superior St., Lieut.-Col. E. F. Norton; Salvage Board Commission on Sale of Materials, 155 East Superior St., Lieut. N. S. Booth; Official Director of Storage, Waste Materials Branch, 1819 West 39th St., Major Zimmerman; Official Director of Storage, Surplus Property Division, 1819 West 39th St., Maj. O. B. Wilcomb; Aircraft Production Board, Consumers Bldg., Capt. G. C. Greider; Signal Corps, 230 East Ohio St., Col. L. D. Wildman.

Cincinnati—Ordnance, 3rd and Vine Sts., W. H. Hopple; Salvage Board Commission on Sale of Materials, Gwynn Bldg., 6th and Main Sts., Lieut. H. L. Slocum.

Cleveland—Ordnance, 2036 East 22nd St., Maj. H. W. Morris; Salvage Board Commission on Sale of Materials, 2036 East 22nd St., Lieut. R. I. Daley.

Dayton—Aircraft Production Board, Maxwell Motor Co., 1st and B. & O. R.R., Lieut. W. B. Strunk.

Detroit—Ordnance, 828 Rock Bldg., Maj. J. A. Bursley; Salvage Board Commission on Sale of Materials, 828 Book Bldg., Lieut. B. T. Reamey; Aircraft Production Board, A.G.S.D. Springwell, Capt. C. A. Reed.

New York—Ordnance, 1107 Broadway, Maj. W. J. Grinden; Salvage Board Commission on Sale of Materials, Albemarle Bldg., 24th St. and Broadway, Mr. Williams; Chemical Warfare, 19 West 44th St., Lieut. J. M. Pattes; Signal Corps, 8-10 Bridge St., Col. C. S. Wallace; Official Director of Storage, Waste Materials Branch, 461 8th Ave., Captain Felix; Official Director of Storage, Surplus Property Division, 461 8th Ave., Capt. R. A. Stewart; Aircraft Production Board, 360 Madison Ave., W. D. Wilkes.

Philadelphia—Ordnance, 1710 Market St., I. H. Francis; Salvage Board Commission Sale of Materials, 1710 Market St., Maj. W. Henderson; Official Director of Storage, Waste Materials Branch, 21st and Oregon Ave., Maj. L. Massie; Official Director of Storage, Surplus Property Division, 21st and Oregon Ave., Major Jones.

Pittsburgh—Ordnance, Chamber of Commerce Bldg., Capt. W. M. Hogg; Salvage Board Commission on Sale of Materials, Chamber of Commerce Bldg., Lieut. G. C. Heistermann; Aircraft Production Board (comes under Buffalo District).

Rochester—Ordnance, 82 North St. Paul St., Maj. W. M. Hasberg; Salvage Board Commission on Sale of Materials, 82 North St. Paul St., Lieut. B. S. Clime.

St. Louis—Ordnance, 613 Locust St., Maj. G. W. Steele; Salvage Board Commission on Sale of Materials, Missouri State Life Bldg., Lieut. C. A. McMullen; Official Director of Storage, Waste Materials Branch, 2nd and Arsenals, Lieutenant Jones; Official Director of Storage, Surplus Property Division, 2nd and Arsenals, Lieutenant Jones.

San Francisco—Aircraft Production Board, 504 Postal Telegraph Bldg., Lieut. R. C. Jordan.

Toronto—Ordnance, 608 Royal Bank Bldg., Capt. C. H. McKnight; Salvage Board Commission on Sale of Materials, 602 Royal Bank Bldg., Capt. C. H. Austin.

Who Designed the Projection Lantern Method of Thread Measurement?

New York, Aug. 1, 1919.

The Editor, *American Machinist*,
10th Ave. at 36th St., New York, N. Y.

Dear Sir:

With considerable interest I have read the copy of a letter published on page 234 addressed to your London office and signed by Bernard P. Dudding.

At the time we started to manufacture the thread inspection equipment which is used by the Bureau of Standards, we went into the matter most exhaustively both with the Bureau of Standards and with H. J. Bingham Powell, Inspector in Charge of the Department of Gages and Standards, British Ministry of Munitions of War in the United States.

The question arose as to whom credit was to be given for the designing of the various machines and after a number of conferences with Mr. Bingham Powell and the Bureau of Standards it was agreed that in our catalog, the angle projection apparatus should be described as follows:

"This angle projection apparatus is the type designed by the Bureau of Standards, Washington, D. C., for the examination of the form of screw threads."

Mr. Bingham Powell was of the opinion that the National Physical Laboratory of England should be given some credit at least for this machine but after reading a letter which we received from H. L. Van Keuren, Chief of the Gage Section, Bureau of Standards, an extract of which is as follows: . . . "However, I have indicated the changes with reference to the projection lantern descriptive matter for the reason that this lantern represents a distinct design made at the Bureau of Standards. The projection principle has been used at the Bureau of Standards for many years." . . . he agreed with us that our description as noted above was correct.

In regard to the lead testing machine we adopted the following description which was approved both by the Bureau of Standards and Mr. Bingham Powell:

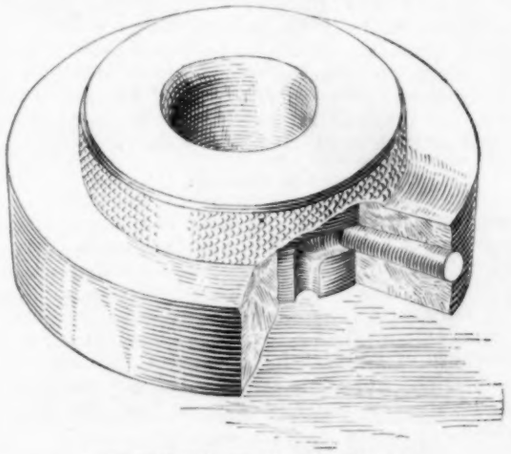
"This optical lead testing apparatus is based on designs furnished to the Bureau of Standards, Washington, D. C., by the National Physical Laboratory of England."

Yours very truly,
Arthur Knapp Engineering Corporation,
19 West 44th St., New York City.
(Signed) Arthur Knapp, President.

Holding Slip Bushings

By A. W. Freeman

Here is a suggestion for holding slip bushings from turning to prevent them from working out while the jig is in use. The sketch shows the construction perfectly. The pin should be a light drive fit.

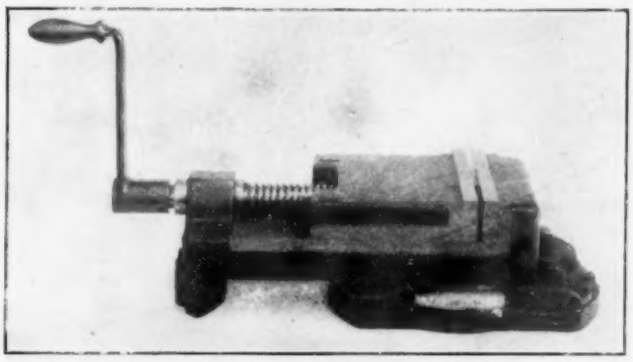


HOLDING SLIP BUSHING

SHOP EQUIPMENT NEWS

Miller & Crowningshield Machine Vises

Miller & Crowningshield, Greenfield, Mass., is now marketing two new sizes of machine vises, these being known as size 4 and size 5½. They are of the swivel type and are graduated so that they can be set to any desired angle or position, in which they can be firmly clamped by



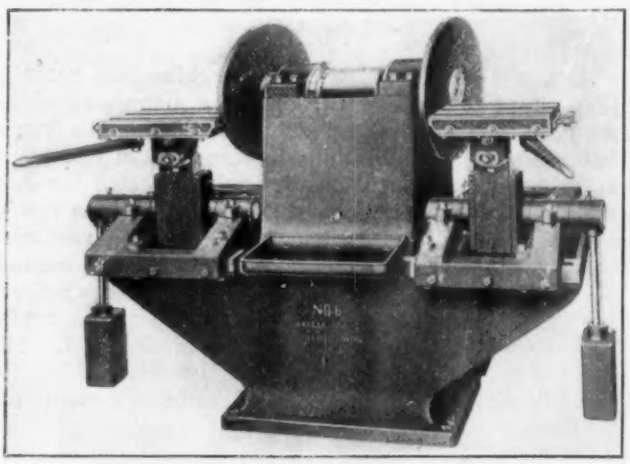
MILLER & CROWNINGSHIELD MACHINE VISE

the two lock screws at the right. It will be noticed that a support is provided under the left end so that this will not spring. The size 4 vise, which has a jaw width of 4 in., a jaw height of 1⅛ in. and opens 2 in., weighs 22 lb., and is furnished with a steel lever handle. The No. 5½ vise has a jaw width of 5½ in., a jaw height of 1⅜ in., opens 3¼ in. and weighs 45 lb. This is furnished with a steel crank handle as shown in the illustration.

Badger Disk Grinding Machine

The Badger Tool Co., Beloit, Wis., is now marketing the disk grinding machine illustrated, the particular features of which are the lever-feed work table, ball-bearing spindle mounting and the construction of the rockershaft. The lever-feed table is said to possess a number of refinements such as an adjustably-attached wheel-truing device, a back stop and micrometer screw stop. Leverage is obtained through a toggle joint action requiring less physical energy on the part of the operator while taking heavy cuts. The pressure increases as the table approaches the grinding disk. In other words the cut is started with light pressure and leverage increased after the sharp points have been removed from the piece being ground.

The ball bearings are protected from grit and dirt by the type of mounting used and provision is made for draining off the lubricant and cleaning the housing. The rockershaft is mounted in a saddle so that it has a

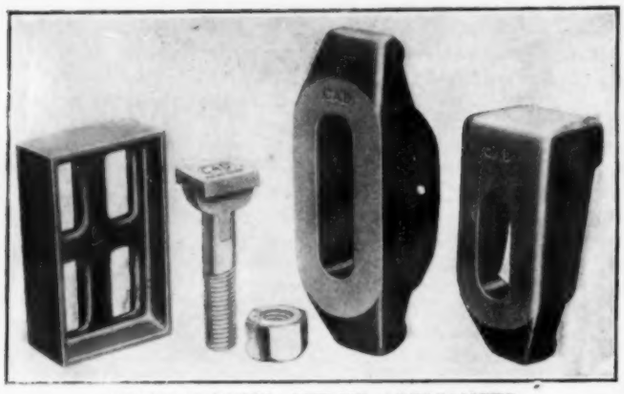


BADGER DISC GRINDING MACHINE

bearing support on each side of the box which supports the lever-feed work table. This added rigidity is said to not only make it possible to do accurate grinding but because of the absence of vibration to make the abrasive disks wear longer.

"Cad" Standardized Set-Up Appliances

The Standard Shop Equipment Co., Inc., 802-803 Real Estate Trust Bldg., Philadelphia, Penn., is now marketing a line of standardized set-up appliances for machine tools which are known under the trade name of "Cad." The illustration shows the standardized bolts and nuts, single and double-end clamps and packing blocks. The bolts and nuts are made in various sizes and lengths as desired, the bolts being made with a double offset on the head, so that they cannot turn in the slot. The nuts are made extra thick and case-



STANDARDIZED SET-UP APPLIANCES

hardened in order to insure long life. The doubled-end clamps are made in lengths of 3, 4, 5, 6, 7 and 9 in., and, in connection with the packing blocks that are made in three lengths, 3, 4 and 6 in. with widths from 2 to 3½ in., are said to enable rapid set-ups to be made. The packing blocks have center steps so as to increase their range. With the single-end clamps no packing is required on a large run of work, but packing can be used where high work is being handled. Single-end clamps are made in five sizes with lengths of 2, 3, 3½, 4½ and 5½ in. and widths of 1¼, 2, 2, 2¼ and 2¼ in. respectively.

Hendey 16-Inch Crank Shaping Machine

A new 16-in. crank shaping machine has recently been added to the line already being manufactured by the Hendey Machine Co., Torrington, Conn. The frame, base and hub for the bull gear are cast in one piece, an oil pan being placed on the inside to catch the drip from all bearings and keep the floor clean. The crankpin is hardened and ground on all wearing surfaces; the crankpin block being also hardened and ground, and bushed with a cast-iron sleeve for the crankpin bearing. The ways for the ram in the frame are at an angle of 50 deg. and are planed from the solid. The gib for the ram is combined with the cap, making for rigidity and at the same time allowing for ample adjustment in a horizontal direction at either or both ends as required. The ram is braced to enable it to carry heavy cuts, and has a bearing in the frame measuring 10 x 29 in. It can be set in any position either while in motion or while idle.

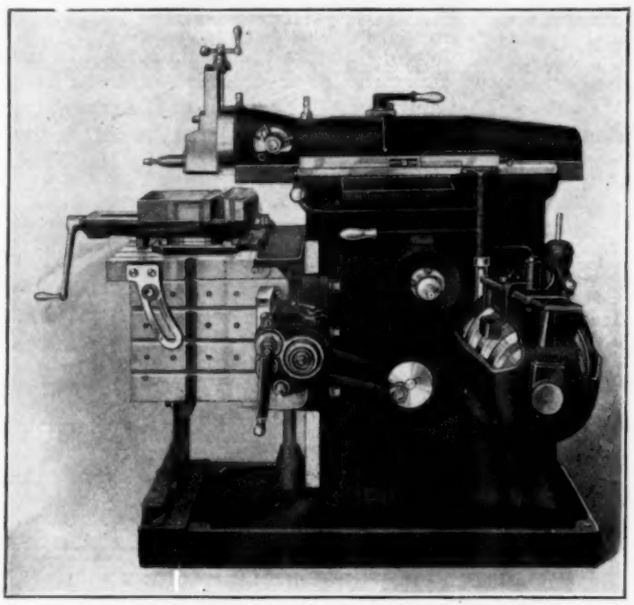
The crossfeed mechanism is operated entirely from one end of the crossrail, a dial with an indicator controlling the amount of feed, which can be varied while the machine is in motion. The feed can be stopped, started, or reversed while in motion by a ball lever on top of the casting. The feed takes place on the reverse stroke only, and the dial on the screw is graduated in thousandths. The tool-head swivel is bound to the head of the ram by a single screw. The downfeed screw is also provided with a micrometer dial reading to thousandths. The power downfeed operates at all speeds and may be set for various feeds in steps of 0.005 in. This device is optional but all rams and heads are so machined that it may be applied at any subsequent time.

The driving cone has four steps, an outboard bearing being used that is mounted in the end of the casting forming the belt guard. An expanding friction clutch engages the cone and is operated by the long horizontal lever at the side. Back gears are used, which in combination with the four-step cone, give eight speeds.

The square-lock method is used for clamping the crossrail to the column, and the elevating screw is of the telescopic type. The tilting-top table is said to be of great convenience in many lines of work, and has an extreme elevation of 25 deg. It is hinged at the rear end on two taper pins, and is clamped on either side, one of the segments being graduated in degrees. The table has an adjustable bottom support which slides on a channel-shaped track serving to protect it from chips.

A quick starting and stopping lever is located conveniently at the side of the machine. This lever has only two inches of motion, but will stop the ram almost instantly in any desired position, saving much of the time ordinarily wasted waiting for the ram to stop. This feature is said to be of great value in setting tools, taking measurements, etc., and also simplifies the throwing in of the back gears.

A vise is furnished that has a graduated base held to the table by four bolts. The boss cast on the under side of the vise supports the vise ways on the table and



HENDEY 16-INCH CRANK SHAPING MACHINE ARRANGED FOR BELT DRIVE

Actual stroke, 16½ in.; horizontal travel of table, 24 in.; vertical travel of table, 15 in.; minimum distance from ram to table, 4 in.; top of table, 14 x 16 in.; side of table, 13 x 15 in.; notches in power crossfeed, 35; range of power crossfeeds, 0.005 to 0.175 in. per stroke; ram bearing in frame, 10 x 29 in.; travel of head slide, 7 in.; power feed of head slide, 0.005 to 0.050 in.; opening of vise jaws, 12¼ in.; size of vise jaws, 12 x 2 7/16 in.; keyseating capacity, 3 in.; size of tools, ¾ x 1¼ in.; diameters of cone pulley, from 7½ to 13 in.; width of belt, 3 in.; equivalent feet of 1-in. belt per stroke of ram for slowest speed, 211 ft., for fastest speed, 29 ft.; strokes per min. of ram, 10 to 125; size of countershaft pulley, 14 x 4 in.; countershaft speed, 365 r.p.m.; size of base, 22 x 50 in.; net weight, 3000 lb.; floor space, 47 x 77 in.

at the same time ties the ways together for added stiffness. The thrust of the screw for the sliding jaw is taken at the head end of the vise casting.

A belt shifter is furnished that is said to be not only a safety device but a time saver. The operation of the handle causes the upper and lower shifting levers to act alternately and to lead the belt from one step to another with a minimum amount of wear and lost time.

If desired the machine may be motor driven, an adjustable speed motor of 3½ hp. running from 400 to 1200 r.p.m. being furnished. This drives directly to the power shaft through a silent chain.

Heald No. 85 Internal Grinding Machine

The internal grinding machine illustrated is a recent product of the Heald Machine Co., Worcester, Mass. This is known as the company's No. 85 machine and is said to be simple, productive and rigidly constructed for small short work. The machine is intended espe-

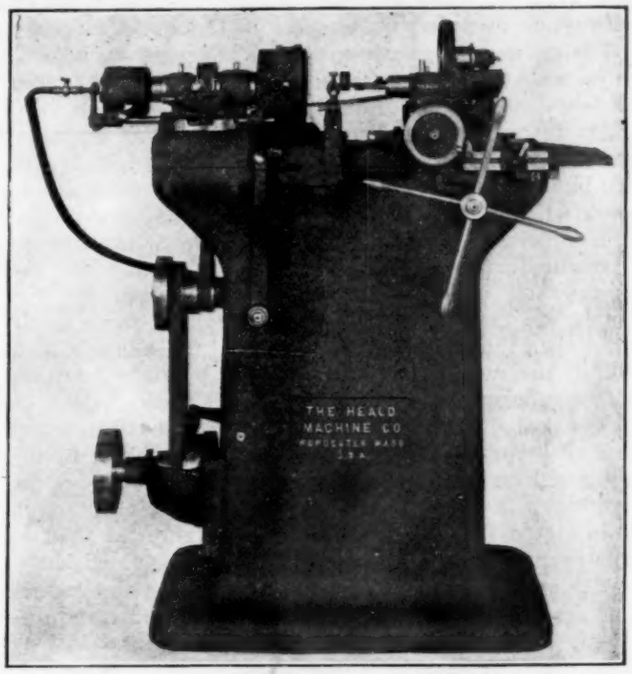


FIG. 1. HEALD NO. 85 INTERNAL GRINDING MACHINE

Swing without water guard, 10 in.; swing inside water guard, 6 in.; depth ground, 4 in.; length of base, 33 in.; table, 35 x 8⅝ in.; distance from floor to chuck spindle, 46 in.; diameter of work spindle bearings, 1⅝ and 1⅜ in.; hole through spindle, ⅞ in.; diameter of work spindle pulley, 4 in.; regular chuck furnished, 3-in. collet with adjustable jaws; head graduated for 45 deg. each side of center or up to 4-in. taper per ft.; work speeds, three, 161, 292, and 528 r.p.m.; floor space, 26 x 50 in.; speed of countershaft, 600 to 820 r.p.m.; tight and loose pulleys, 10 in. in diameter, 2¾-in. face; net weight, 1100 lb.; standard equipment includes countershaft, one collet chuck with adjustable jaws with capacity for work ⅛ in. to 3 in. in diameter, one grinding wheel head of the size desired, one dozen grinding wheels, pump, tank and water guards for wet grinding, diamonds and diamond bridge and necessary wrenches.

cially for work ranging from ¼ to 2 in. in diameter and up to 4 in. long, and is particularly valuable on holes smaller than ¾-in. diameter 1½ in. long. The actual swing inside the water guard is 6 in. while without the guard it is 10 in. A conveniently located pilot wheel furnishes hand-feed movement to the table, and a quick-acting lever-operated collet with an automatic brake for the work head reduces the chucking time to a minimum. This lever also serves to shut off the water.

The work head is driven by a crossed belt from a pair of cone pulleys on the base, these giving three speeds, 161, 292 and 528 r.p.m. The head is arranged to swivel, and is graduated to indicate movements up to 45 deg. or 4 in. of taper per foot. The movement of the work head is automatically stopped and the water shut off when the grinding wheel is withdrawn from the work, this being accomplished by a friction clutch in the base operated by a lever at the front of the machine. As the table moves to the right a small dog attached to it engages the lever and throws out the clutch. To resume work, the operator simply pushes the lever back into its vertical position starting the work head and the water. The work head is bolted directly to the base and is fitted with dustproof bronze bearings adjustable for wear. The work spindle is made of steel ground and lapped, the front bearing having a diameter of 1⅝ in., while the rear bearing has a diameter of 1⅜ in.

The holding fixture consists of a quick-acting collet chuck having a capacity from ⅛ to 3 in. This is operated by a lever that has an adjustable compensating device to prevent the work being distorted.

The cross-slide feed is calibrated to read to quarter-thousandths, the feed lever being placed at the left side of the cross-slide to enable the operator to keep his right hand on the pilot wheel while using his left to feed the slide. The main table has flat- and V-ways and has a positive stop accurately governing the travel and allowing work to be ground up to a shoulder or any other given point without danger of overrunning.

An over-head countershaft is used as it is claimed that countershaft attached to a machine of this size creates considerable vibration. The countershaft has steel hangers, self-aligning ball bearings, driving pulley, drum for flexible idler, and tight and loose pulleys to receive power from the main line.

The wheel guard automatically covers the wheel as it is drawn from the work and prevents danger of the operator's hands being injured. The idler pulley is fitted with ball bearings and is of the flexible type, keeping an even tension on the spindle and countershaft belts at all times. The water equipment furnished includes pump, tank, water guard and connections. While the water tank with pump is of large capacity it fits into the back of the base and requires but a few more inches of floor space than the machine itself.

The machine is equipped with a Type 10 wheel head having a solid adjustable taper bearing at the wheel end and ball bearings at the pulley end. These heads are made up in complete units in themselves each having its own pulley to insure the correct spindle speed.

A head known as Style 200 can be furnished allowing different sized quills to be inserted into the nose of the

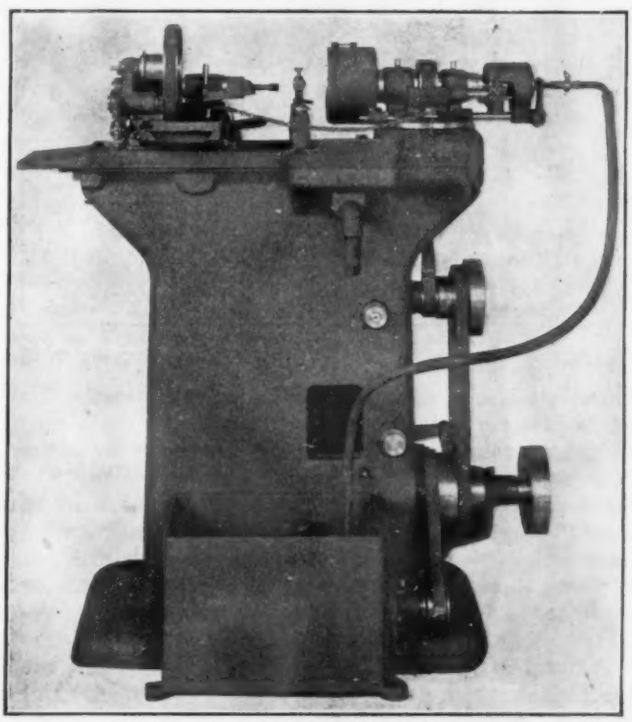
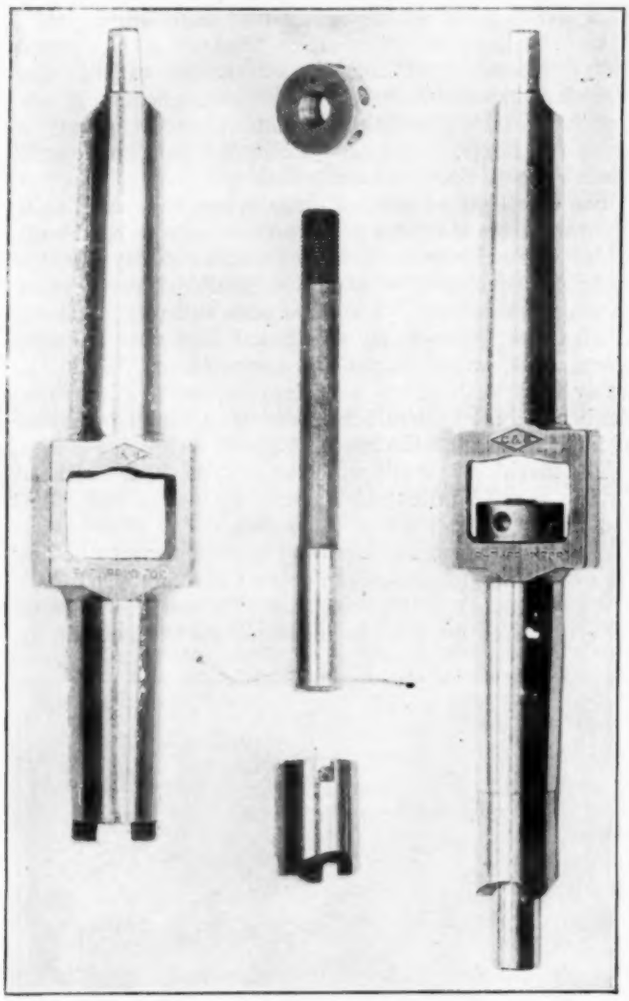


FIG. 2. A REAR VIEW OF THE MACHINE

spindle. These quills are tapered and when put into place in the end of the spindle have a firm grip. The quills are furnished in $\frac{1}{4}$-, $\frac{5}{16}$- and $\frac{3}{8}$-in. sizes with lengths from 1 to 2½ in. The standard style heads with solid spindles are furnished in $\frac{7}{16}$ to ½-in. sizes, with lengths of spindle nose from 2¼ to 3½ inches.

Chapin & Baker Counterboring and Facing Tool

The counterboring and spot-facing tool illustrated is made by the Chapin & Baker Manufacturing Co., 143 Edison St., Syracuse, N. Y. The holder is made of



CHAPIN & BAKER COUNTERBORING AND FACING TOOL

nickel steel and the cutter of high-speed steel. The cutter is secured to the holder by means of an internal shoulder against which the pilot is drawn by means of a capstan nut in the center of the holder. This makes the tool as solid and strong as if made in one piece. The teeth of the cutter are ground with a slight hook which causes the chips to roll out freely instead of being broken up into small pieces. The tools are made in various sizes to suit the trade.

A number of locomotives, built in a hurry and with insufficient supervision, leaked badly when put into service. A competitor happened to meet the manager of the locomotive shop and sarcastically asked him what *mesh* boiler plate he was using now!

The Machine-Tool Situation in Europe

By Harry W. Champion
President, Newton Machine Tool Works, Inc., Philadelphia, Penn.

There seems to be a decided tendency in England toward specialization in the manufacture of machinery and of introducing production methods to reduce costs. The great increase of wages makes reduced costs of production necessary to compete in the world markets.

The railway shops are in need of many machine tools, as in this country, but as many of these tools are more or less special and often very heavy, they are very likely to be of local manufacture. The fact remains, however, that some of the more progressive managers are buying heavy tools in this country so as to get to work quickly with the most modern machinery.

The increased cost of materials and labor must cause a readjustment of ideas and prices but has not yet reached all cases. Heavy, special machines for example, are being quoted in some cases at a much lower price than the present costs warrant. This cannot last, but in the meantime heavy-machine builders here are at a disadvantage.

The coal situation is having its effect on all industry and the ever-mounting cost of fuel is reflected in the price of iron and steel and other products. We are delivering both coal and steel in Great Britain, although it is stated that steel is sold at a lower price than in this country. This, however, is not a new condition.

The exact effect of four years of war on the men is not easy to determine. Many of the skilled men were exempted or even brought back from the front to give more valuable service in the shops. But it is safe to say that neither skill nor productivity have been increased by army life. Then, too, the unemployment pension has its effect on the desire for employment, particularly where several members of the same family are among the beneficiaries. This, of course, cannot continue indefinitely as the world needs production more than ever before. But just how to abolish the pension or payment method without seriously disturbing the political situation is a difficult question.

France and Belgium both present entirely different problems. The Belgium shops were gutted and systematically robbed of everything worth while. What could not be taken was rendered useless in most cases. But the towns are not destroyed by shell fire as in France, and many of the shops only require a new supply of machinery to begin work. Many machines have already been ordered from various sources.

The towns in northern France are so shattered as to require tearing down the remaining walls, clearing away the débris and rebuilding from the ground up. On this account, as well as because of fear of a repetition of the German attack, many industries are moving to the center or south of France. The population of Lyon, for example, has increased greatly and other towns and cities are also feeling the result of the changing location of industrial centers.

On these and other accounts, there is more hesitation and delay in getting back to normal lines of work. There is, perhaps, a very natural tendency to wait until they see what someone else is going to do. Political uncertainty is also playing its part in delaying reconstruction.

The coal situation is also very important to France and Belgium. From present appearances we must supply both coal and iron for several years to come.

Standardization and Interchangeability

The letters which follow give the experience of two well-known engineers on the subject of "Standardization and Interchangeability," as brought out by the article on page 1143, Vol. 50:

I read the article on standardization and interchangeability with interest and appreciation and I subscribe to what is said. I had to work out that very problem myself.

Our first requirement was quality of material. Rejections due to quality were made irrespective of any other attributes of the parts or assemblies.

The quality being satisfactory, measurements were held to fairly close limits for shop inspection but the supervising inspector had wider limits and the salvage room could use even greater discretion. Pieces that were too small, of course, had to be turned down and if possible were worked over into other parts. Pieces that were too large we were not above fitting at assembly. This policy we pursued because it cost but little if any more to fit the piece than to re-process it or replace it; also we saved material and during the war material was more precious than its price. Moreover, by following this policy we speeded up production because in each case we saved some time.

One is always in danger of being led astray by a fetish and it is easy to strain one's eyes so that the policy of the use of standardization and the development of interchangeability of parts may become a fetish.

This situation is complicated by the fact that while it is not difficult to get inspectors who can reject pieces on account of quality or dimension that is not exactly as per specifications, it is, indeed, difficult to get inspectors and mechanics who can apply the spirit of specifications and not throw down parts or assemblies which are good enough. We found it necessary, therefore, to educate and train some supervising inspectors and our superintendents and foremen so that the necessary judgment would be applied.

This article strikes home. I appreciate it and applaud it.

F. G. COBURN,
Commander, Construction Corps, U. S. N.

I have carefully read your article and agree with the statements made. Personally I am a strong believer in making parts interchangeable, the degree of interchangeability to be based entirely upon the class of work in question.

Furthermore, I strongly recommend the use of go and no-go gages for all kinds of manufacturing in quantities in preference to using micrometers and other miscellaneous measuring tools. This works along the line of interchangeability and close limits referred to.

I am also a strong believer in selective assembly where parts are made to extremely close limits, as this, I believe, is necessary to eliminate unnecessary waste. We actually found in the manufacture of time fuses in Canada that the limits in many cases were extremely close. These limits were set by the engineer at Woolwich Arsenal, figured on a peace-time basis. After getting into the manufacture of the fuse and using common sense it developed that a good many of these limits could be changed and this was actually done, with coöperation, and in this way we were able to increase our production and produce equally as good fuses.

This is a fair example of what can be done in practically all kinds of manufacturing if the man who sets the limits is working in close touch with the management, who would base his opinion entirely upon the question of interchangeability on the kind of product manufactured.

In the case of machine tools, as you mention in your article, it has always been the custom to leave a certain amount of stock for fitting. This is quite essential in many cases, particularly in the case of machine tools, as they are usually manufactured in small quantities, which would not justify the expense of making the parts absolutely interchangeable. For instance, in fitting bevel gears it has always been a practice to leave stock on the back for fitting. While it is quite possible to make bevel gears interchangeable, this means additional expense and could only be done in a case of being made in very large quantities.

I have always been a strong believer in working to close limits, making the parts interchangeable and using a complete system of limit gages. If there is any lee-way to be allowed, leave it to the chief inspector, who would take such questions up with the management, making proper record of each concession. I would not take the bars down in the shop, except in such cases where it was actually found from experience that a greater tolerance could be allowed and still secure the desired result.

In the case of cylinders and pistons, referred to in your article, I strongly recommend making these parts absolutely interchangeable as the limits should be such that it would not be difficult to work within the specified limits making the parts interchangeable, which is all possible today with the modern machinery which is being used.

In the case of balls which is given, there are many articles of this nature which, due to their method of manufacturing, could be made practically to an absolute size, and a standard must be maintained in all articles of this kind.

I thoroughly believe that, with the experience gained in the manufacture of munitions, we are all going to change our ideas of manufacturing. I personally believe the aim will be to make work more accurate and to closer limits, which means a higher education of our mechanics. This is all necessary if we are to increase production and be able to produce our goods economically and at a profit while maintaining our present high rate of wages and cost of manufacturing.

C. R. BURT,
General Manager Russell Motor Car Co.

Using the Compound Rest for Accurate Tool Setting

By William L. Dobbins

In the formula for accurate tool setting by Joel Sundell on page 1080, Vol. 50, of the *American Machinist*, Mr. Sundell evidently assumes that the advance of the tool in a direction at a right angle to the work is in direct ratio to the division of an angle of 90 deg.—a theory which is entirely wrong. In making this criticism I am prompted not by a desire to find fault, but rather to prevent others from being led into error by formulas that are incorrect.

The advance of the tool directly toward the work will equal the advance of the compound rest multiplied by the sine of the angle at which the compound rest is set in relation to the axis of the work, therefore the following would be a correct formula:

A = advance of tool at right angle with work;
B = amount removed on diameter of work;
C = angle of compound rest with axis of work;
D = actual movement of tool rest.

$$A = D \times \text{Sin. } C$$

$$B = 2A = 2D \times \text{Sin. } C$$

$$D = \frac{A}{\text{Sin. } C}$$

With the compound rest set at an angle of 45 deg. there would be an advance of the tool directly toward the work equal to 0.001 × sin. 45 deg. which, expressed in inches is 0.000707+ instead of 0.0005 in. as the writer states. For a movement of 0.0005 in., we would have to set the compound rest at an angle of 30 deg. to the axis of the work. At an angle of 50 deg., there would be an advance equal to 0.001 × sin. 50 deg. or 0.000766+ in. instead of 0.00005 in. as stated.

Sparks from the

Ships Redelivered in Three Weeks Nearly 3,000,000 Tons

During the first three weeks of July, 135,000 deadweight tons of shipping were redelivered to the Shipping Board at United States ports. This brings the total army tonnage redelivered to 2,848,000 deadweight tons, according to announcements by the War Department.

August redeliveries are forecast as 50,000 tons of cargo and 57,000 tons of troop.

"There remain in operation in the army's transatlantic fleet 1,032,000 tons of troop, 6000 tons of refrigerator and 54,000 tons of cargo ships," the Department said; "128,000 tons are out of operation awaiting redelivery.

"The last ten ships to be redelivered averaged ten days each. This is one day less than the average for the week previous."

* * *

The Coming of the Super-Rifle

That the Ordnance Department has no intention of letting the experience gained in the war go by the board or of ever again facing a recurrence of the 1917 situation, says Miriam F. McConaughy, is evidenced by the recent publication of specifications for a new semi-automatic shoulder rifle and the extending of an invitation through the technical journals to inventors or other interested persons to submit such inventions along this line as might measure up to requirements.

It was found during the war that such a weapon would be of tremendous value, combining the speed and ease of shooting of the automatic with the transportability of the service rifle. The French already have such a weapon and issue it at the rate of 16 per company.

The new rifle is to be capable of use either as an ordinary service rifle or as an automatic loading rifle, the change from one to the other to be simply and rapidly effected. Its weight must not exceed 10 lb. It should be capable of using the 10-round Browning magazine or a similar one. The main requirements are: "It must be a self-loading type capable of firing a cartridge between 25 calibre and 30 calibre of good military characteristics and preferably to fire U. S. cartridge, 30 calibre, model 1906. It must be simple and rugged in construction, capable of being placed in the hands of the ordinary soldier and requiring but little more attention than the regular service rifle."

The date given for the formal competitive tests of such weapons is about Mar. 1, 1920. Prior to that time, however, preliminary examination will be given to submitted rifles if the inventors so desire, thus giving them an opportunity to work on the weak spots as shown in these tryouts before the competitive tests.

The specifications are exacting and the tests rigid, for this is to be a super-rifle. Tests will be made for accuracy, speed and ease in dismounting and assembling, simplicity of construction, speed, velocity, endurance, powder pressure, action and strength of mechanism and imperviousness to weather conditions. The last is tested by closing the mechanism, tightly corking both ends of the barrel and exposing the rifle for two minutes to a blast of fine sand. The surplus sand may be removed by blowing on the rifle, jarring it or wiping with the bare hands only. Twenty rounds are then fired with the magazine empty when exposed to the dust, and another 20 with the magazine loaded when exposed to the dust. The mud-proof test is made by treating the rifle similarly before immersing it in a mudbath, prepared by mixing two parts water with five parts pulverized clay, where it remains for two minutes before being removed, the ends of the barrels cleared of corks and such cleaning done as may be accomplished with the bare hands. Three bursts of 10 shots each are then fired.

In short, it is hoped to obtain a weapon combining the best points of the Springfield—and doing away with its greatest weakness, the stiff bolt action—the model 1917 and the Browning automatic in one light shoulder rifle. Whether the United States, already the leader of the world in small arms, will produce such a weapon or not remains to be seen.

The new weapon is not necessarily to be adopted in place of the present service rifle; it may be used as the French use it, merely as a supplementary arm to be issued to certain troops in the same manner as the machine guns and automatics were issued.

* * *

Cast Iron Made From Steel Scrap in Electric Furnace

A development of war conditions in the steel industry of the United States has been the demonstration of the possibility of making pig iron and iron castings direct from steel scrap in an electric furnace—something never accomplished before. It has been claimed that such iron, cast in the form of castings, is far superior to the same castings made from ordinary pig iron, melted and cast. Tests of this new iron recently made at Columbia University demonstrate its high quality. Its tensile strength was shown to be 40,730 to 45,030 lb. per square inch, considerably higher than of ordinary cast iron.

Bureau of Standards Closes New York Branch

The New York branch of the Bureau of Standards has been closed on account of the lack of sufficient appropriations to carry on this branch of the work in New York City. Glenn B. Harris, mechanical engineer, who has had charge of this work, will still remain in New York City. He can be communicated with by addressing him at 400 West 151st St., or by telephoning Audubon 5235-J, on matters pertaining to the work of the Bureau of Standards.

* * *

Poland's Immediate Requirements

Local committees representative of the industrial world in Poland have combined to study the question of their immediate wants, and their meetings will probably assume a permanent character, says the *London Times*. Meanwhile, they have compiled a list of articles required at once, as follows: Steam motors (18,600 hp), 240; electric dynamos and transformers (76,000 kw.), 3000; sundry machinery utensils, 4400; apparatus parts, copper, 4500 tons; apparatus parts, iron, 30,000 tons; apparatus parts, other, 11,000 tons; metals, exclusive of iron and steel, 2700 tons; steel for utensils, 1700 tons; belt conveyors, shafting; belt conveyors, leather, 1100 tons; cables and electric wire, 2200 tons; and metal articles, as follows: Assembly pieces for brushes (fastening the tops of cards), 5000 tons; beet-sugar knife blades, 15,000; bronze knives and fittings for paper making, 90 tons; oil cans, refractory crucibles, 15,000; telegraph and telephone apparatus; articles for electrical installations of every description; carbon and lithographic paper; polishing materials; pharmaceutical goods.

* * *

Trend of Brazil's Trade

The United States during the last five years has become the chief factor in Brazil's import trade. In 1918, when Brazil's total imports aggregated $247,000,000, the United States supplied commodities valued at $89,000,000, while British shipments to Brazil amounted to only $50,000,000. In 1913, Great Britain led in exports to Brazil, supplying her with goods valued at $80,000,000, and the United States exporting $57,000,000.

* * *

Steel Mill To Expand

James A. Campbell, president of the Youngstown Sheet and Tube Co., has announced additions will be built to the plate mill to cost half a million dollars. The Carnegie Steel Co. will add an 18-in. band mill to the McDonald works.

World's Industrial Forge

By E. C. Porter
News Editor

Holtzer-Cabot Rewards Faithful Employees

The Holtzer-Cabot Electric Co., of Roxbury, Mass., recently presented $100 to every man and woman who had been in the employ of the company for 10 years or more. Over 25 per cent. of the 700 employed in the plant received this amount. This concern has a very small labor turnover, as it has a factory management committee which works along modern lines with the several shop committees, and this works out to the mutual advantage of the management as well as the employees.

* * *

New Railroad in Russia

The Daily Consular and Trade Report, issued by the United States Department of Commerce, July 9, 1919, contains a statement from the *Svensk Handelstidning* of April 3, transmitted by Trade Commissioner Norman L. Anderson, of Stockholm: "The Russian government is said to have lately given concessions to a Norwegian-American syndicate to exploit the enormous resources of Northern Russia."

Of particular interest to the machine industry is the fact that this concession includes the building or a new railway approximately 2000 miles long. This is to be a standard-gage road from Ob in Siberia westward to Petrograd, opening a new country rich in forests and minerals.

This should provide a market for large quantities of steel and road-building material, as well as machine tools and supplies of various kinds. This statement is also verified by the correspondent of the Paris *Temps*.

* * *

Machine-Tool Situation in Europe

A correspondent, who is particularly well known in the machine-tool industry, writes that the machine-tool trade in France seems to be moving along in a fairly satisfactory manner. Those who have stocks of the right kind have no difficulty in selling them in France, and there is a great scarcity of many kinds of machines.

The Belgians, who have always been noted for their keeness in trading, are refraining from purchasing at the present war prices in the hope that machines can be secured at a lower price a little later. Belgium was one of the hardest territories in which to sell machine tools before the war, and they do not take kindly to the increased prices, no matter what justification there may be for their existence.

Italy will doubtless have more difficulty than any other of the big nations in changing over from a war to a peace basis. Many new shops were organized for the manufacture of munitions, and these will have to find commercial products for manufacture before they can change to a peace basis. This is bound to take considerable time, and in the meantime labor must be employed in some way.

Our correspondent is of the opinion that the Balkan countries will prove good ground to cultivate during the next few years, because when the war started we were just getting established in Greece with prospects of good business. This was not alone in machine tools, but included power equipment of all kinds (electric, steam and oil) and in small-tool supplies and hardware. The same condition probably applies in Asia Minor, in Servia, Bulgaria and Roumania. The opportunities for American trade will be greatly increased in those countries with the establishment of a few branch banks which, it is understood, are to come before very long.

* * *

$100,000 Steel Plant

Announcement has been made that G. Haarman & Co., who has a structural steel and iron plant at Holyoke, has bought the Hampden County fairground at Willimansett and plans to build an addition to the Holyoke shops on the site. An outlay of $100,000 is involved.

Although the company has not definitely decided how many buildings will be put up on the new site, it was said that there would be at least one structure costing $25,000. Two sheds now on the ground will be moved, remodeled and used as foundries. Officials of the company estimated that 100 men would be employed at the plant.

* * *

Steel Scrap Available for Export

The Panama Canal Commission is soliciting bids on the following items of steel scrap now classified and ready for delivery at the Isthmus: Five hundred tons No. 1 steel rail; 50 tons No. 2 steel rail; 300 tons No. 1 cast steel; 3150 tons No. 1 heavy melting steel, and 1500 tons No. 2 heavy melting steel. For particulars, communicate immediately with the General Purchasing Officer, The Panama Canal, Washington, D. C.

* * *

Ninth Convention of the Railway Tool Foremen's Association

The ninth annual convention of the American Railway Tool Foremen's Association, which has been postponed for two years on account of the war, will be held at the Hotel Sherman, Chicago, on Aug. 27 to 29, inclusive.

Trade Currents from Cleveland and Chicago Districts

CLEVELAND LETTER

The first week of August has brought a change that has been anticipated for a long time by the far-sighted leaders in the machinery and equipment field in this locality, in that lathe prices have advanced 15 to 20 per cent. during the period. This upward movement in prices is now believed to be the fore runner of higher figures for other machine tools. The immediate effect was to bring more inquiries, and more actual orders, to those interests which are known to specialize in this class of equipment. This in turn has brought more business for the period than in any similar week in recent normal years. It is significant, however, that there is less shopping around by the bigger consumers now; these going direct to the manufacturers and distributors known to have the equipment desired. For this reason, leading machinery men point out, the Cleveland trade has fewer miscellaneous inquiries than would be the case without this influence of higher prices.

While a considerable quantity of material is finding its way into local consuming channels, the principal outlet is in territory more distant from Northern Ohio, notably New York, the New England States, Wisconsin, Illinois and Michigan. Michigan by far exceeds other districts in demand, because of the varied needs of automobile manufacturers. The middle of August is expected to see the beginning of the rush of automobile interests from this and other states for equipment which will be needed to start the manufacture of the 1920 cars. The new models will be later in being produced this year than formerly, and for this reason it is expected that manufacturers will be particularly interested in immediate delivery of equipment, for the initial shipments of new model cars will be attempted early in October.

Many Cleveland interests, under this influence, now are of the opinion that the machinery industry is now on the brink of a period of prosperity that will be induced by the fact that the country is about four years behind in normal production of almost all kinds. There is nothing to indicate, however, that large orders will be placed here for some time to come, and the feeling is that business will be confined for the present to individual equipment needed to round out present shops.

The F. B. Stearns Co. is one of the first to prepare for increased demands upon it for automobiles by planning the immediate construction of a manufacturing building in connection with

its main Cleveland plant. Equipment will be decided upon, according to George W. Booker, president, as the building nears completion.

The Ohio Blower Co. plans to extend its production of automobile bodies, and to this end is erecting a large addition to its present West Side plant here. Its needs for sheet-metal fabrication equipment also will be announced later.

W. S. Vrooman, formerly office manager of the Cleveland Tool and Supply Co., has been appointed general office manager of the Cleveland Duplex Machinery Co., and will devote particular attention to sales correspondence.

Chicago Letter

A large Chicago corporation engaged in the manufacture of paper specialties recently decided to equip a complete shop for the making and repair of their automatic machinery. For this purpose they purchased from a local dealer two large lathes, a milling machine, a gear shaping machine and several punching machines of varying sizes. The same dealer in the last few days has sold a 62-in. boring mill to a manufacturer of deep-well pumps, a large horizontal boring mill to an automobile builder and four gear generators to a maker of refrigerating machinery, as well as two manufacturing milling machines to a scale factory, all in territory adjacent to Chicago.

The above extracts from the order books of one machinery concern illustrate the wide range of industry which is buying machine tools today, and thereby keeping business in this line at a high pitch. Dealers are almost unanimous in stating that July was the best month of the year and in one instance, a dealer whose sales have increased every month since March reports that July business more than doubles June, and tops any previous month in the firm's history.

Sales are still spread through the entire line of machinery, from small drilling machines to large boring mills, with lathes of all sizes still the most popular item. The Pollak Steel Co. of Cincinnati is about to equip a drop-forge plant in Chicago and is out with a list of requirements including several large traveling cranes, steam drop hammers, furnaces, drilling machines and trimming machines. Aside from this, no large lists have been made public, the bulk of the business coming from shoppers who buy from dealers' stocks. No further price advances have been recorded this week, although they are confidently expected.

The tractor plant of the International Harvester Co., employing 1200 men, has reopened after being shut down for 19 days. No other changes in the industrial situation, so far as manufacturing industry is concerned, have occurred. A lockout of the building trades, on account of numerous strikes in various trades, has tied up building completely, but it is hoped that it will not last sufficiently long to seriously retard the erection of new plants.

Obituary

B. Frank Barnes, widely known for his inventions in upright machines, died suddenly on Tuesday evening, July 26, at Eau Claire, Wis.

Mr. Barnes was born in Mount Morris, N. Y., sixty-six years ago. He went to Rockford when a boy and

B. FRANK BARNES

attended the Lincoln school. He then went to work at the machinist trade, which he mastered thoroughly.

For twenty-five years prior to 1899, Mr. Barnes was superintendent of the W. F. & John Barnes plants on South Water St. In 1899 he organized the B. F. Barnes Co., and was president until about June of 1907, when he sold out his interests. The name of the industry was then changed to the Rockford Drilling Machine Co

The Barnes Drill Co. was organized and incorporated in July of 1907 by B. F. Barnes, who had been president of the company ever since.

Personals

Charles E. Hildreth, chief of the machine-tool section of the War Department, has resigned.

Andrew A. Rolan has resigned as mechanical engineer of the U. S. Ordnance Department to accept a position as assistant general manager of the American Electric Heater Co., Detroit, Mich.

Arno W. Gaebelein, formerly captain in the Ordnance Department, is now in charge of the newly established offices of the New Britain Machine Co. at 50 Church St.

John McGrath, formerly connected with the Ingersoll-Rand Co. and the Bethlehem Steel Co., has just returned from foreign service in the Engineering Corp of the A.E.F., and has associated himself with the D. M. Osborne Machinery Co., Cleveland, Ohio, in the capacity of salesman and production engineer.

H. F. Cameron, of the Lake Charles Railway Light and Power Co., has been appointed vice president and general manager of the Texas Gas and Electric Co., and will have his headquarters in Houston, Texas.

C. O'C. Sloane announces his resignation from the Allied Machinery Co. of America on July 26, in order to accept a position with the Betts Machine Co., Rochester, N. Y.

Karl G. Roebling, president of the John A. Roebling's Sons Co., Trenton, N. J., has been elected a director of the American Ship and Commerce Corp., New York City.

A. W. Houston has resigned his position as vice president and general manager of the Texas Gas and Electric Co. to accept a similar position with the Southern Utilities Co. Mr. Houston will have his headquarters in Houston, Florida, and will have the supervision of plants of the Southern Utilities Co., in the States of Florida and Georgia.

Forthcoming Meetings

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

American Railway Tool Foremen's Association will hold its ninth annual convention at the Hotel Sherman on Aug. 27 to 29, inclusive. Charles N. Thulin, 935 People's Gas Bldg., Chicago, is the secretary.

The American Steel Treaters' Society will hold its annual convention and exhibition at the Seventh Regiment Armory, Chicago, Ill., Sept. 1. Al. J. Murphy, 154 East Erie St., Chicago, Ill., is chairman of the exhibit committee.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of the odd months. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

International Railway General Foremen's Association will hold its annual convention Sept. 2 to 5 inclusive, at the Hotel Sherman, Chicago, Ill.

The International Railroad Master Blacksmith's Association will hold its annual convention in Chicago, Aug. 19, 20 and 21. The location of the meeting in Chicago will be announced later. A. L. Woodworth, 752 West N St., Lima, Ohio, is the secretary.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

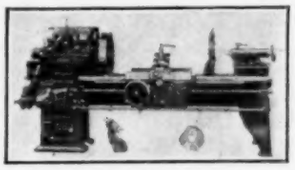
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Lathes, Geared-Head

Cisco Machine Tool Co., Cincinnati, Ohio.

"American Machinist," July 31, 1919.

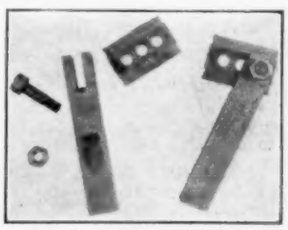


These geared-head lathes are made in 14-, 16-, 18-, 24-in. sizes; can be used with either belt or motor drive, and are arranged to give 10 speeds with motor drive and 20 with a double-friction countershaft. The gears are all operated by four levers or handles including the back-gear lever, a pull-pin in the face gear being used to run directly from a spindle when the back gears are thrown out. The horsepowers recommended for the 14-, 16-, 18- and 24-in. sizes are 2½, 3, 5 and 7½ respectively.

Toolholders, Roughing

Chapin & Baker Manufacturing Co., 143 Edison St., Syracuse, N. Y.

"American Machinist," July 31, 1919.

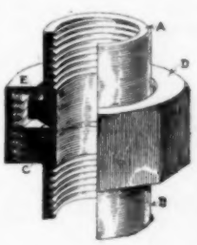


This illustration shows a shaping machine tool with a small setscrew in the fork for adjustment and a larger one in the recess, for taking up any play that may appear between cutter and holder. The blades have four cutting edges and are formed to any required angle. It has a sliding pin within the holder which is held against the back of the cutter by the square-head setscrew shown in the figure, thus locking it firmly in place. The cutter has four cutting edges and thus reduces the number of trips to the crib for regrinding.

Pipe Union

The Codd Tank and Specialty Co., 117 South Hanover St., Baltimore, Md.

"American Machinist," July 31, 1919.



The four-seated pipe coupling shown in the illustration consists of five parts, a male and female section threading on the ends of the pipes to be joined, a coupling nut and two washers made of soft metal. The male member *A* and the washer *C* are machined to form a ball joint surface. The female member *B* is recessed to contain the washer *C*. The male member *A* is also provided with a recessed flange which holds the washer *E*. The lip of the coupling nut *D* bears on the top of the washer *E*. The use of soft-metal washers in contact with the hard metal of the main parts is intended to prevent corrosion and leakage.

Hose Coupling, Improved, Quick-Acting "Thor"

Independent Pneumatic Tool Co., Chicago, Ill.

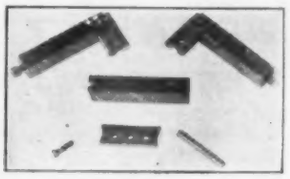
"American Machinist," July 31, 1919.

This quick-action hose coupling of the sliding-sleeve type is universal, there being no male or female ends. There is a locking collar on each hose end, and when the coupling is made these locking collars or sliding sleeves work in opposite directions. They can only be disconnected in the sleeve by a straight pull on the sliding sleeve at each end. It is not necessary to twist, and the jaws separate as soon as the locking shoulder moves back. An L-shaped gasket is used, and when the coupling is connected it is held in place by air pressure. The gasket cannot be blown out when the coupling is disconnected, because of a projecting shoulder in the coupling.

Toolholders, Turning

Chapin & Baker Manufacturing Co., 143 Edison St., Syracuse, N. Y.

"American Machinist," July 31, 1919.

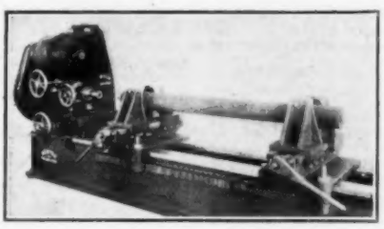


The turning toolholder shown in the illustration has a high-speed-steel formed cutter with three drilled holes which is held by a through bolt in the end of an alloy-steel shank. The holes permit of making the maximum use of the cutter as it can be fed out as the cutting edge is ground away.

Centering Machine

Newton Machine Tool Works, Inc., 23rd and Vine Sts, Philadelphia, Penn.

"American Machinist," July 31, 1919.

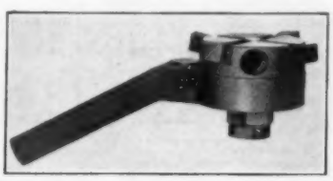


This machine is intended for centering rough and irregular forgings. It has the following specifications: Diameter of spindle, 3 in.; in-and-out adjustment of spindle, 8 in.; vertical adjustment of spindle, 4 in.; cross-adjustment of spindle, 4 in.; length of base, 16 ft.; width of base, 22 in.; distance from center of vise to top of base, 5¼ in.; maximum distance from center of spindle to top of base, 17½ in.; minimum distance, 13½ in.; capacity of vises, rounds from 2 in. to 12 in. in diameter.

Toolholder, 4-in-1 Lathe

Windau Tool Co., 1565 East 17th St., Cleveland, Ohio.

"American Machinist," July 31, 1919.

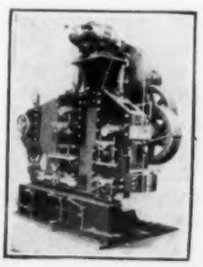


This 4-in-1 lathe toolholder is locked, unlocked and indexed by a wrench. A screw adjustment with ¼-in. travel is provided to take up the wear on the cutting tools and the turret is ground to fit the shank seat. The shank is a drop-forging and the turret is made from cold-rolled steel, both parts being pack-hardened. The size of the shank is ⅝ x 1¼ in. and the turret will take bits ⅝-in. square. The tool is shipped with four blank high-speed bits and a wrench.

Punching and Shearing Machine

Joseph T. Ryerson & Son, Chicago, Ill.

"American Machinist," July 31, 1919.



Made in six sizes numbered from 1 to 6 and having the following respective capacities: For plate up to ¼ in., ⅜ in., ½ in., ⅝ in., 1 in., 1¼ in.; bars up to 1 in., 1¼ in., 1½ in., 2 in., 2½ in., 3 in., coping and notching capacity up to 3-in. I-beams, 6-in. I-beams, 8-in. I-beams, 10-in. I-beams, 15-in. I-beams; punching capacity for holes up to ⅝ in. in ⅝-in. plate, ¾ in. in ¾-in. plate, ⅞ in. in ⅞-in. plate, 1 in. in 1-in. plate, 1¼ in. in 1¼-in. plate, 1½ in. in 1½-in. plate; approximate weights, 3000, 5500, 10,000, 18,500, 37,000, 55,000 lb.; horsepower required, from 1 to 3 for No. 1 up to 25 to 30 for No. 6.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$30.35	$30.35
Northern Basic	27.55	27.55
Southern Ohio No. 2	28.55	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	32.40	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	35.20	33.95
BIRMINGHAM		
No. 2 Foundry	28.00	26.25
PHILADELPHIA		
Eastern Pennsylvania No. 2	30.65*	30.65
Virginia No. 2	32.10–34.10†	30.85
Basic	30.90*	29.90
Grey Forge	29.90*	29.90
CHICAGO		
No. 2 Foundry local	26.75	26.75
No. 2 Foundry, Southern	28.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	28.15	28.15
Basic	27.15	27.15
Bessemer	29.35	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	— New York —			— Cleveland —		— Chicago —	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.15	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.45	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.45	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	4.995				
Plates, ¼ to 1 in. thick	3.67	4.27	4.495	3.57	4.20	3.67	4.45

Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, N. Y.	$2.62	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	— New York — Current	One Yr. Ago
No. 10	3.55	4.64	4.57	5.80	4.57	5.495
No. 12	3.60	4.69	4.62	5.75	4.62	5.545
No. 14	3.65	4.74	4.67	5.90	4.67	5.595
Black						
*Nos. 18 and 2p	4.15	5.24	5.17	6.75	5.30	6.295
*Nos. 22 and 24	4.20	5.29	5.22	6.80	5.35	6.345
*No. 26	4.25	5.34	5.27	6.95	5.40	6.395
*No. 28	4.35	5.44	5.37	7.05	5.50	6.495
Galvanized						
No. 10	4.70	5.79	5.97	....	6.20	6.845
No. 12	4.80	5.89	6.07	7.30	6.25	6.945
No. 14	4.80	5.89	6.07	7.30	6.30	6.945
Nos. 18 and 20	5.20	6.19	6.37	7.60	6.60	7.245
Nos. 22 and 24	5.25	6.34	6.52	7.75	6.75	7.295
*No. 26	5.40	6.04	6.67	7.90	6.90	7.445
*No. 28	5.70	6.79	6.97	8.20	7.20	7.745

* For painted corrugated sheets, add 30c. per 1000 lb. for 25 to 28 gage: 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 13%
Cleveland	5% off	List plus 13%
Chicago	2% off	List plus 13%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$15.00 19
Cleveland	20.00	20.00
Chicago	16.50	19.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 5/64, 3/32, 1/8, 5/32, 3/16 No. 8, 7/32 and No. 10	21.00 to 30.00	1/8 by 12 in. long	14.00
1/4		1/4 by 19 in. long	12.00
No. 12		3/8 by 19 in. long	10.00
5/16, No. 14 and 1/8		1/2 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/16	33.00
Domestic 20c. for 1/16, 15c. for 1/8 to 3/16.		1/8	30.00
		3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	8.40	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
1/8, 1/4 and 3/8	50½%	24%	3/8 to 1 1/4	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	3/4 to 1 1/4	39½%	24½%
1/2	51½%	39%			
3/4 to 1 1/4	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	— New York — Black	Galvanized	— Cleveland — Black	Galvanized	— Chicago — Black	Galvanized
1/8 to 3 in. steel butt welded	47%	31%	43½%	34½%	57½%	44%
2½ to 6 in. steel lap welded	42%	27%	45½%	30½%	53½%	41%

Malleable fittings. Class B and C, banded, from New York stock sell at 12½% off. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	22.75	15.37½	26.00
Tin in 5-ton lots	70.00	72.50	94.00
Lead	5.75	5.25	5.05
Spelter	7.75	6.05	8.62½
ST. LOUIS			
Lead	5.50	5.00	7.75
Spelter	7.40	6.20	8.37½

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	— New York — Current	One Month Ago	One Year Ago	— Cleveland — Current	One Year Ago	— Chicago — Current	One Year Ago
Copper sheets, base	32.50	22.50	42.00	34.50–36.50	38.00	36.50	33.00
Copper wire (carload lots)	28.25	23.00–28	47.50	30.50	35.00	26.00	33.50
Brass sheets	25.00	23.75–28	39.125	33.00	37.00	28.00	31.50
Brass pipe	35.50	34.00–37	39.00	39.00	40.00	37.00	41.50
Solder (half and half) (case lots)	45.00	46.50–41	45.00	41.00	62.00	38.50	70.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$21.25	$32.25
New York	24.25	34.25
Cleveland	30.00	35.00
Chicago	27.00	29.50

Shop Materials and Supplies

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f. o. b. mill 11.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	12.95	18.75	13.30	18.40
New York	12.00	16.50	12.50	17.00
Chicago	16.50	22.00	16.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	10.00	13.35
Chicago	10.25	13.50
Cleveland	12.00	16.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy and crucible	19.00	23.50	18.00	24.00	18.50
Copper, heavy and wire	18.00	22.50	17.00	23.00	18.00
Copper, light and bottoms	15.50	20.50	16.00	21.00	17.00
Lead, heavy	5.00	7.00	5.00	7.00	5.125
Lead, tea	3.75	5.25	3.50	5.50	4.00
Brass, heavy	12.50	14.75	13.50	16.50	17.50
Brass, light	8.50	11.00	10.00	12.50	11.00
No. 1 yellow brass turnings	10.00	13.00	11.00	14.00	11.50
Zinc	4.50	6.25	5.00	6.50	5.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	35c.–37c.	32.00c.	33½c.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	27.00	42.00
Chicago	31.00	38.00
Cleveland	35.50	36.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	125.00	80.00	108.00	72.00	100.00
Commercial	50.00	70.00	18.50	23.00	18.00	24.00

SHOP SUPPLIES

New York prices will be revised in next week's issue.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	$1.50	+$2.50	$2.25	$1.40	$2.00	$1.05
Hot pressed hexagon	1.50	+2.50	2.25	1.20	2.00	.85
Cold punched hexagon	1.50	+2.50	2.25	.75	1.30	1.00
Cold punched square	1.50	+2.50	2.25	.75	1.30	1.00

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	50-10%	40%
Chicago	50%	50%
Cleveland	60-10-10%	60%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
¾ by 4 in. and smaller	50%	50%	50–10%
Larger and longer up to 1¼ in. by 30 in.	40%	40%	40–10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York.....$1.25 Cleveland.....$3.75 Chicago.....$2.25

For cast-iron washers the base price per 100 lb. is as follows:

New York.....$6.00 Cleveland.....$3.75 Chicago.....$4.00

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
¾ by 6 in. and smaller	45–5%	40–5%	50%
Larger and longer up to 1 in. by 30 in.	35%	37½%	50–5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	List plus 10%	10%	List plus 10%
Chicago	20%	List price	20%	List price
New York	40%	20% from list	20%	10½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	50–10%	60%	45%
Tinned	50–10%	60%	40%

Boiler, ½, ⅝, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York...$5.25 Cleveland...$4.00 Chicago....$4.87 Pittsburgh...$4.65

Structural, same sizes:

New York...$5.35 Cleveland...$4.10 Chicago ..$4.97 Pittsburgh...$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	39.50	38.50
Brass	33.00	39.00	37.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., the advance is 5c. over base (100-lb. lots); for less than 50 lb., but not less than 25 lb., 10c. should be added to the base price; and for quantities of from 10 to 25 lb. the extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet-metal mouldings if ordered in above quantities. The above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼ up to 2 in inclusive in rounds, and ¾ up to 1½ in., inclusive in square and hexagon—all varying by thirty-seconds up to 1 in. and by sixteenths over 1 in. On all shipments aggregating less than 100 lb. there is usually a boxing charge of $1.50.

LONG TERNE PLATE—For No. 28 primes, from Stock, the price in Chicago is $7.50 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	13.00	11.00–13.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	11.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½ x 13½	13½ x 20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.75	2.75	2.40
Chicago	2.00	2.00	2.25

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.65	$3.65	$4.30
Cleveland	3.62	3.62	4.60
Chicago	4.12½	4.50	4.00

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past five weeks:

	Aug. 7	July 31	July 24	July 17	July 10
Prompt furnace	$3.90	$3.85	$4.00	$4.00	$4.25
Prompt foundry	5.00	5.00	5.00	5.00	5.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	per ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$2.15	$1.86	$2.15	$2.00	$2.48	$1.97
5-gal. cans	2.28	1.96	2.40	2.15	2.68	2.17

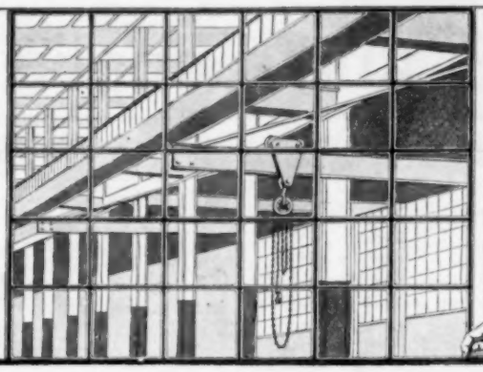
WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	13.00	14.50	14.00	14.50	13.00	14.00
25 and 50-lb. kegs	13.25	14.75	14.25	12.75	13.25	14.25
12½-lb. keg	13.50	15.00	14.50	15.00	13.50	14.50
5-lb. cans	15.00	16.50	.....	.....	15.00	16.00
1-lb. cans	16.00	17.50	.....	.....	16.00	17.00

500 lb. lots less 10% discount; 2000 lb. lots less 10-2½% discount.

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies



Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Bridgeport Brass Co., Grand St., is having plans prepared by H. M. Lane Co., Arch., 701 Owen Bldg., for a 1 story, 150 x 220 ft. casting shop. Estimated cost, $150,000.

Conn., Bridgeport—The city has had plans prepared for a 2 story garage, stable and storage building to be erected at Seaside Park. Estimated cost, $50,000. E. G. Southey, Arch., 983 Broad St., will receive bids until Aug. 16.

Conn., Bridgeport—The Cornwall & Patterson Manufacturing Co., 1730 State St., manufacturer of piano and organ hardware, has awarded the contract for a 1 story, 145 x 160 ft. addition to its factory. Estimated cost, $50,000.

Conn., Hartford—C. W. Cramer, 217 Main St., plans to build a garage. Estimated cost, $35,000.

Conn., Hartford—The Hartford Buick Co., 51 Elm St., has had plans prepared for a 2 story, 40 x 60 ft. office and show room, 1 story, 90 x 100 ft. garage with 30 x 30 ft. ell, on Washington St. P. A. Sellew, Arch., 756 Main St., will receive bids until Aug. 15.

Mass., Adams—The Berkshire Cotton Co. has awarded the contract for the erection of a 2 story, 40 x 80 ft. addition to its mill. Estimated cost, $20,000.

Mass., Northampton—J. W. Riley, 132 Pleasant St., plans to build a 1 story, 55 x 175 ft. garage and service station. Estimated cost, $30,000.

Mass., Springfield—The Springfield Tool Co., Inc., 125 Dwight St., has awarded the contract for a 1 and 2 story, 90 x 200 ft. factory and office on Depot and 2nd St. Estimated cost, $55,000. Noted Aug. 7.

R. I., Providence—C. B. Bullock, 9 Seekonk St., plans to build a 1 story, 21 x 120 ft. garage, 21 x 79 ft. ell. Estimated cost, $30,000.

R. I., Providence—K. B. Ely, 1 Reservoir Ave., has awarded the contract for a 1 story, 50 x 85 ft. garage and service station. Estimated cost, $30,000. Noted July 24.

R. I., Providence—The Estate of R. G. Davies, 236-240 Meeting St., plans to build a 3 story, 50 x 135 ft. garage and service station on Meeting St. Estimated Cost, $50,000.

R. I., Providence—H. H. Ford, Thurston St., plans to build a 1 story, 44 x 84 ft. garage and service station on Thurston St. and Elmwood Ave. Estimated cost, $25,000.

R. I., Providence—J. Goldman, c/o Page & Page, Arch., 87 Weybosset St., plans to build a 2 story, 69 x 143 ft. garage and service station on Benefit and Jenckes St. Estimated cost, $50,000.

R. I., Providence—T. F. and W. F. Hussey, 226 Williams St., plans to build a 1 story, 50 x 183 ft. garage. Estimated cost, $35,000.

R. I., Providence—M. Kellman, 38 Wickenden St., plans to build a 1 story, 87 x 99 ft. garage. Estimated cost, $30,000. Page & Page, 87 Weybosset St., Arch.

R. I., Providence—H. P. Quinn, Turks Head Bldg., has awarded the contract for a 2 story, 50 x 100 ft. garage and service station to be erected on Friendship St. Estimated cost, $25,000. Noted May 22.

R. I., Providence—The Weeden Land Co., Industrial Trust Bldg., plans to build a 1 story, 60 x 95 ft. garage and service station on Broad St. Estimated cost, $18,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Fenway Apartment Co., St. Paul and 34th St., plans to build a 2 story, 54 x 108 ft. garage. Estimated cost, $55,000

N. J., Matawan—A. P. Munning, c/o Lockwood-Greene & Co., Arch., 101 Park Ave., New York City, has awarded the contract for two 2 story, 42 x 115 ft. and 42 x 152 ft. electric plating factories. Estimated cost, $35,000. Noted July 3.

N. Y., Buffalo—Pratt & Lambert, 79 Tonawanda St., manufacturers of varnish, plan to build a 2 story addition to their plant. Estimated cost, $22,000.

N. Y., Falconer—The Falconer Iron Works is building a 2 story, 40 x 120 ft. addition to its plant on Main and Daw St., and will install about $5,000 worth of machine tools.

N. Y., New York (Borough of Bronx)—J. Pederson, 148th St. and 3rd Ave., is having plans prepared by Moore & Landseidel, Arch., 148th St. and 3rd Ave., for a 1 story, 65 x 155 ft. garage, to be erected on West Farms Road and 176 St. Estimated cost, $30,000.

N. Y., New York (Borough of Bronx)—The Valo Realty Co., 1018 East 163rd St., will build a 1 story, 50 x 195 ft. garage on Washington Ave. Estimated cost, $12,000.

N. Y., New York (Borough of Brooklyn)—S. Z. Ageloff, 126 Reid Ave., will build a 1 story, 100 x 125 ft. garage on Bainbridge St. near Lewis Ave. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—R. Fouster, 40 Myrtle Ave., will build a 1 story, 100 x 100 ft. garage, on Myrtle and Lewis Aves. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—I. Levy, 17 Marry Ave., will alter his 2 story, 100 x 100 ft. garage on Metropolitan Ave., near Graham Ave. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—M. Segar, Passaic, N. J., will build a 1 story, 105 x 135 ft. garage on Coney Island Ave. near Foster Ave. Estimated cost, $25,000.

N. Y., New York (Borough of Manhattan)—The Eberhardt Realty Co., 413 East 137th St., will build a 1 story, 50 x 60 ft. garage on White Plains Ave. and 219th St. Estimated cost, $12,000.

N. Y., New York (Borough of Manhattan)—The J. Hoffman Brewing Co., 211 East 55th St., will alter its 3 and 4 story brewery into a garage and build an addition to same. Estimated cost, $50,000. Noted July 10.

N. Y., New York (Borough of Manhattan)—The J. M. B. Realty Co., 30 East 42nd St., is having plans prepared by Gronenberg & Leuchtag, Arch., 303 5th Ave., for a 1 story, 100 x 200 ft. garage, to be erected on 158th St. near the New York Central R. R. tracks. Estimated cost, $75,000.

N. Y., New York (Borough of Manhattan)—J. Kennedy, 378 Front St., plans to build a 2 story garage at 361-365 South St. Estimated cost, $60,000. L. A. Sheinart, 194 Bowery, Arch.

N. Y., New York (Borough of Manhattan)—J. O'Leary, 227 East 57th St., has had plans prepared by J. M. Felson, Arch., 1133 Broadway, for a 4 story, 55 x 100 ft. garage, to be erected at 225-227 East 67th St. Estimated cost, $50,000.

N. Y., New York (Borough of Queens)—H. J. Houpert, Harris Ave. and Marion Place, machinist, has awarded the contract for alterations and a 1 story addition to his factory. Estimated cost, $25,000.

N. Y., New York (Borough of Queens)—The Tide Water Oil Co., 11 Broadway, New York City, is building a garage and warehouse, in Long Island City. Estimated cost, $200,000.

N. Y., Schenectady—The LeValley, McLeod, Kincaid Co., manufacturer of plumbing supplies, has awarded the contract for a 3 story, factory to be erected on Van Guysling Ave. Estimated cost, $75,000.

N. Y., Syracuse — The Brown, Lipe, Chapin Co., 110 Seneca St., manufacturer of gears, plans to build a 5 story, 70 x 78 ft. factory on Ontario and West Fayette St. Estimated cost, $125,000. G. L. Noble, Union Bldg., Arch.

N. Y., Syracuse—The H. H. Franklin Manufacturing Co., 302 South Geddes St., has awarded the contract for a 7 story, 120 x 240 ft. factory, to be erected on West Marcellus and Magnolia St. for the manufacture of automobiles. Estimated cost, $400,000.

N. Y., Syracuse—The Glenside Mills Co. has purchased the plant of the Syracuse Rug Works and plans to install machinery. Estimated cost, $15,000.

N. Y., Syracuse—The Hammond Steel Co., 1400 Milton Ave., Solway, has awarded the contract for a 40 x 60 ft. and 80 x 260 ft. factory. Estimated cost, $250,000.

N. Y., Syracuse—The Onondaga Co., East Water St., has increased its capital stock from $150,000 to $1,000,000 and plans to build several additions to its plant on James St. and Thompson Road, to include a 40 x 160 ft. annealing plant. S. S. Buckley, Pres.

N. Y., Syracuse—The United States Hoffman Co., Taylor St., manufacturer of machinery, has purchased the plant of the Van Wie Pump Co., 709-722 West Fayette St., and will install machine tools. Estimated cost between $20,000 and $25,000 J. B. Spencer, Gen. Mgr.

Penn., Erie — The Ball Engine Co., 12th and Cranberry St., plans to build a 1 story, 115 x 185 ft. addition to its shovel shop. Estimated cost, $65,000. Osborn Engineering Co., 2848 Prospect St., Cleveland, Ohio, Engr.

Penn., Philadelphia—P. Grant, 113 Chestnut St., is having plans prepared by E. A. Wilson, Arch., 1208 Chestnut St. for a 2 story, 50 x 98 ft. garage and machine shop, to be erected on Marsden and Longshore St.

Penn., Philadelphia—J. D. Murphy, 30th and Reed St., manufacturer of textiles, has awarded the contract for the erection of a 62 x 115 ft. addition to its plant. Estimated cost, $20,000.

Penn., Pittsburgh—The Pittsburgh Gage and Supply Co., 30th St. and Liberty Ave., has awarded the contract for the erection of a 6 story, 98 x 130 ft. addition to its factory for the manufacture of washing machines, etc. Estimated cost $200,000. Noted Aug. 7.

Penn., Wilkesbarre—J. Luksic is having plans prepared by H. Maier, Arch., Coal Exchange Bldg., for a 2 story, 54 x 180 ft. garage, to be erected on Washington St. Estimated cost, $50,000.

Penn., Wyncote—D. Wentz has awarded the contract for the erection of a 1½ story, 56 x 97 ft. garage. Estimated cost, $30,000.

SOUTHERN STATES

Ala., Birmingham—The Ensley Motor Co., Ave. H, has awarded the contract for a 2 story, 75 x 140 ft. garage, repair shop and sales building, to be erected on Ave. E and 20th St. Estimated cost, $45,000.

Ga., Atlanta—The Lanham Cotton Cultivator Co., 425 Empire Bldg., manufacturer of cotton chopper-cultivator, has purchased a 200 x 480 ft. site and is having plans prepared for the erection of a factory. C. Tichenor, Pres. Noted July 3rd.